THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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MAGNETIC ALLOYS OF MANGANESE.

AN interesting discovery has been made by Dr. Fr. Heusler, of the Isabellenhütte, Dillenburg. Whilst experimenting with an alloy of manganese and tin, he noticed that it was strongly attracted by an accidentally magnetised tool. On melting the alloy with an equal weight of copper, he found the resulting combination also distinctly magnetic. He also succeeded in making magnetic alloys by adding tin to commercial copper-manganese containing only 1·2 per cent. of iron, this copper-manganese itself being perfectly non-magnetic. On making experiments with other metals, it was found that arsenic, antimony and bismuth each had effects similar to tin, but aluminium gave the best results of all. With the help of Messrs. Richarz, Starck and Haupt, a thorough investigation of the whole subject has been carried out, and many interesting discoveries have been made.

It has been found that the most magnetic alloys are those in which the manganese and aluminium are present in direct proportion to their atomic weights. For example, an alloy of manganese 27·1 per cent., aluminium 12·3 per cent., and the remainder copper, gives the following magnetic curve:—

H	20	40	100	150
B	3,800	4,350	4,975	5,250

In fact, some of the alloys, for the lower values of H, are magnetically as good as annealed cast-iron.

The transformation temperatures of the alloys (*i.e.*, the points at which they lose their magnetism) are comparatively low. An alloy containing 16 per cent. Mn and 8 per cent. Al becomes non-magnetic at 165° C., and remains so if plunged into cold water; it becomes magnetic again, however, if kept at a temperature of 110° C. for a day or two. By adding small quantities of lead the transformation points may be brought down to still lower temperatures (*e.g.*, to 60° C.).

In connection with these curious results, it should be mentioned that manganese had already some claim to be classed as a magnetic metal, for it is well known that some of its salts are almost as magnetic as those of iron. Some readers may also remember that twelve years ago Mr. T. W. Hogg exhibited before the British Association two pieces of alloy, one of which contained Fe 14·8 per cent., Mn 75·4 per cent., C 5·6 per cent., Al 3·1 per cent., Si 0·9 per cent. Although the proportion of iron was not large, the alloy was strongly attracted by a magnet. The very magnetic iron-aluminium alloys shown not long ago by Prof. Barrett, may possibly be a further exemplification of the action of aluminium in bringing out or increasing magnetic properties.

The remarkably low temperatures at which the new alloys lose their magnetic properties open up possibilities of practical application in various directions. For example, they might be used for fire-alarms, closing (or opening) an electric circuit by the release of an armature when the trans-

formation temperature was attained. Or the device invented by Mr. E. Berliner, in 1885, for generating electricity direct from heat by heating and cooling iron armatures in a magnetic field, might be realised, though we fear that the latter is too sanguine an anticipation.

The new alloys are strong, not difficult to work, and not easily oxidized; for this last reason they may have an advantage over iron in some situations, though for ordinary use the price would be prohibitive. The discovery, however, is an important addition to our knowledge of magnetic materials, and may lead the way to further progress in practice. In conclusion, we may refer readers to Dr. Heusler's original paper "Uber die Synthese ferromagnetischer Manganlegierung" (N. G. Elwert, Marburg, 1904), from which most of the information in this article has been obtained.

The Jerry Electrician.

THE jerry electrician, says *Everyday Electricity*, "is a product of an age of cut prices," and as such is more to be pitied than blamed. Whether he be an object for commiseration or no, he is a menace to the well-being of the electrical industry, just in the same way as the common thief is to honest folks generally.

Among other laudable objects, one of the aims of the Electrical Contractors' Association is to weed out the incompetent, and raise the status of the genuine wireman. Whilst this may do much to check bad work, it will not prevent the "jerry electrician," who will, of course, not be a member of the Association, from carrying out wiring contracts at prices below the actual cost of first-class material alone. It is possible that in the long run we shall have to call in the aid of legislation to protect the public, as well as the electrical industry, in a manner somewhat after the lines of those which the District of Columbia is now proposing to adopt. A Bill has been introduced into Congress for the regulation of electric wiring in the district of Columbia, and it has now reached the Committee of the District of Columbia on the House side. If this Bill becomes law it will be necessary not only for electrical contractors to take out licenses in order to engage in electrical work, but the general public will be made responsible for seeing that none but licensed contractors are so employed. It will be unlawful for any person, firm, or corporation, to act as owner or lessee of any electrical generating plant in the district without first having obtained a permit, and it will be illegal also for any person acting as an employé of any other person, firm, or corporation, to operate any plant or machinery for the generation or utilisation of electricity for light, heat, or power without having first taken out a license. If we understand this aright, and our information is derived from *Electricity*, New York, it would appear that not only must a company obtain a license, or what generally takes the form of a provisional order in this country, but all the employés from the chief down to the shift engineer, must obtain a license before they can be permitted to take up a position in an electric light station. So far as contractors are concerned, all applicants for a license as electrical contractors would need to pass some examination, and satisfy the Commissioners as to their capabilities, and they would also be required to file in the office of the Commissioners a bond with satisfactory sureties in the sum of $2,000 for the due performance of any work which they might undertake, such work to conform with the requirements of the Commissioners. No person under 21 years of age would be licensed. The fee for a license as contractor would be $5 per annum, and the fine for carrying out any contracting work which is defined as "putting in place wiring and apparatus necessary for the production and utilisation of electric current for lighting, heating, and for power," would not be less than $5 for each and every offence or imprisonment for not exceeding one month. This in itself might probably not act as sufficient deterrent to the jerry electrician, who might risk the fine in order to make an illegal profit. But there is a further provision to the effect that any person who shall knowingly employ an electrical contractor who has not been regularly licensed would also be subject to a fine of not less than $5 and not more than $100, and in default of payment imprisonment for a period not exceeding six months. The latter provision would probably be more effectual than the former, but we can scarcely think that the condition of electric wiring in this country, bad as it is sometimes made out to be, is bad enough to call for such drastic measures as the above. We think that the Association already mentioned will be able to effect a great deal in the direction of weeding out the price-cutting jerry-wiring contractor, and jerry wiremen might even in course of time, become an extinct species.

The Consumer's Deposit.

WITH reference to the article upon this subject which appeared in our issue of May 27th, a correspondent has drawn attention to Section 27 (3) of the Schedule to the Electric Lighting (Clauses) Act, 1899, upon which we did not make any comment. The enactment in question is as follows:—"Provided always, that the undertakers may, *after they have given a supply of energy in respect of any premises*, by notice in writing require the owner or occupier of those premises, within seven days after the date of the service of the notice, to give them security for the payment of all moneys which may become due to them in respect of the supply, in case the owner or occupier has not already given that security, or in case any security given has become valid or is insufficient; and, in case any such owner or occupier fail to comply with the terms of the notice, the undertakers may, if they think fit, discontinue to supply energy for the premises, so long as the failure continues." It is contended, apparently, that this section enables a company to discontinue supply if a deposit is not given when demanded. In our view, this is not the correct interpretation of the section. In the first place, it is by no means certain that the words "shall give security" mean "shall pay a deposit." If this is the true meaning, the company would, apparently, have power to obtain the deposit of all moneys which may ever become due to them from the consumer. In the second place, the assumption that a company can demand a deposit at any time, and even before the supply commences, gives no effect to the words which are printed in italics. It is at least arguable that no security can be demanded until the company have supplied power, and have failed to obtain payment therefor. It is worthy of notice that by Sec. 52 of the same schedule, which gives the company power to sell or hire out meters to consumers, it is specially provided that *previously* to supplying any such meter the undertakers may require the consumer to pay them a reasonable sum in respect of the price of the meter, or to give security therefor.

The usual form of provisional order also contains the following provision:—

> Every owner or occupier of premises requiring a supply of energy shall . . . . give to the undertakers (if required by them so to do) security for the payment to them of all moneys which may become due to them by such owner or occupier in respect of any electric lines to be furnished by the undertakers, and in respect of energy to be supplied by them.

This gives the company power to demand a deposit from every consumer, and so clears up a doubt which was

expressed in the article in our issue of May 27th*; but it does not expressly give the company power to refuse to supply if the deposit is not paid. It is true that by the other provision which we have considered, the supply may be stopped if security is not given after the supply has commenced; but we do not see that a company have any express power under their provisional order to refuse to give a supply to a consumer whose financial stability they have no reason to suspect.

Comparative Efficiency of Internally and Externally-fired Boilers.

Mr. Robb, who writes in the *Engineering Magazine*, has collated some tests on boilers with internal and external furnaces, from which he comes to the conclusion that boilers with furnaces of the type of the Lancashire boiler furnace are more efficient than Dutch-oven furnaces or other external furnaces, in which much heat is locked up in brickwork seating. His own design of boiler is simply a large circular furnace with a water jacket, arranged with smoke tubes beyond the furnace, and water-leg connections to a drum above half full of steam. All water-tube boilers are, of course, liable to the loss of heat which is absorbed by the brick seating and walls, especially if dampers are badly fitted; but the external furnace is a necessity if water-tube boilers are to be employed. Mr. Robb's own internal furnace much resembles the arrangement of the Hornsby boiler, and it has the bad feature that, beyond the end of the grate, there is no combustion space, and though a large furnace is good for combustion, space is also necessary, and this is not provided. The Dutch oven type of furnace is good for smoke prevention, but, no doubt, it occupies space and loses a good deal of heat by radiation. But the water-tube boiler may be so set with a furnace quite under it, instead of projecting in front, though this necessitates placing the boiler much higher than usual. There is, of course, no reason why the internal furnaces of the Lancashire boiler should not discharge into brick-lined tubes, so as to conserve temperature where needed. So treated, the Lancashire boiler, with careful treatment, would be more easily made smokeless, and the temperature in the down-take would also probably be more suitable for superheating.

Over-Running Powers.

We have little to add to our leading article of May 6th on the general subject of electric tramway running powers. The House of Commons Committee, which has been considering the application of the Tyneside Tramways Co. for powers to run cars over the lines of the Newcastle Corporation, has arrived at a decision which confirms that already pronounced by the Lords' Committee. The company and the corporation have been conducting negotiations for some weeks past to see whether they could come to terms, but such negotiations have proved unsuccessful. Consequently, last week there was a four or five days' contest in committee room, with the result that the Corporation lost the day, the preamble of the Company's Bill being approved, notwithstanding the alleged unanimity of the Newcastle Councillors in opposition to the proposal, and the strong support which was lent to their case by the municipal electric tramway departments of other large cities. Slowly the truth is being driven home that municipalisation is not the great end of all things, that the public interests are not identical with municipalisation and its parochial limitations, and that undue restriction of facilities for speedy travel is not to be permitted.

* Page 891, paragraph 6.

CHILLED-IRON v. STEEL-TIRED WHEELS.

(*Concluded from page* 943.)

Too often chilled wheels have been condemned because they have been put to work under conditions against which the best cast-iron in the world could not stand, and the makers of the alternative wheel have taken care that before they put their speciality in competition the conditions are at least ameliorated.

When one knows that the rail gauge on two routes of the same system has differed by as much as $\frac{1}{4}$ in.; when one knows that over 60 chilled wheels have been ruined within one week because the flange was designed by a clever man with no practical knowledge, and that wheels bearing different tape marks are not uncommonly pressed on the same axle; when tales are told of engineers who will have curves tight to gauge while others have them wide, of some who put in special curve rails and some who do not; and when one bears in mind that many shop foremen have no respect for the indications of a pressure gauge, and are not yet aware that an allowance of at least $\frac{1}{8}$ in. has to be made for bending in service when gauging the wheels on axles up to $3\frac{3}{4}$ in. diameter; then it becomes a matter for surprise that chilled wheels average in miles as high as they do. Under similar conditions, steel tires would disgrace themselves equally.

The success of any kind of wheel depends on many things, the chief of which are the intelligent management of the repair shop, proper construction and maintenance of track, and reasonably careful drivers. The chilled wheel must have all three conditions favourable to give the best results, but the steel wheel does not care quite so much about the driving.

Given fair treatment in the shops, a well-aligned and gauged track, and a magnetic or pneumatic slipper brake for service use, we are confident that the life per unit of radial depth of tread will be so high as to raise the chilled wheel above competition on the score of direct economy.

But, in addition to the direct saving which appears to accrue at present from the use of steel tires (*vide* Mr. Simpson's comparison), there is to be taken into account the indirect, but relatively more important, economy which is said to be introduced by the better treatment of the rails and special work by steel tires.

One gentleman has the temerity to assert, and to be content with the mere assertion, that the life of the rails is increased "about" 25 per cent. by the adoption of steel tires. While we are prepared to accept the general opinion that chilled wheels damage special work more than the other type, we cannot admit, without the production of well authenticated measurements, that the remainder of the track will be more injuriously affected by one than by the other.

Everyone who has used steel tires, says that braking is improved, and that "flats" are lessened in number. That is a most important point in favour of the tire, so long as braking is effected by friction at the wheels, for it is flats which form the greatest number of chilled wheel casualties.

To the flat-beridden manager there are three courses open. The first is to make his drivers more efficient, and to see that the brake-men in the sheds do their work properly. The second is to adopt steel tires; and the third is to replace the wheel-brake as a service brake by some form of slipper-brake; not to combine the two if it can be avoided.

Flat wheels are seldom caused by soft spots, being usually the direct outcome of bad driving. If a motorman takes a car out with the brakes properly adjusted—and it is his duty to see that they are so before leaving the depôt—there can be no valid excuse for flatting the wheels, unless it can be proved that the supply of sand failed at the critical moment, in which case the driver should be treated as inefficient.

A manager must not say without due inquiry that steel tires are to replace chilled wheels. He has to remember that 30-in. tired wheels are useless, as they cannot be run to their full life on account of the previous arrival at the limiting clearance between motors and paving. The least possible diameter is $31\frac{3}{4}$ in., and it is not at all improbable that the design of the car will not admit this increase without more or less extensive alterations. The brake-gear

might or might not present difficulties, but the chief thing to fear is the lack of clearance between the new wheels and the under-frame of the car-body. So small is this clearance in many cases, that the flanges of 30-in. wheels have worn through the flooring, and brake-rods have been jammed between tops of motor cases and under-frames.

It is obvious, therefore, that wheels $1\frac{3}{4}$ in. deeper would be impracticable in such cases, and might cause the same trouble when 30 in. gave none.

The day is surely coming when the 33-in. wheel will be the standard, and the man who is not bound by tradition, or is capable of thinking for himself, will see that the next cars he buys have not only 33-in. wheels, but good clearance all round them. He will see, too, that they are mounted on axles certainly not less than 4 in. diameter.

The great radial wear, which it is necessary to get out of steel tires in order to make them pay, puts another difficulty in the way of their use on surface contact or conduit lines, on both of which systems it is of the first importance that the vertical movement of the current collector shall be reduced to a minimum.

We are not surprised, therefore, to read that Wolverhampton "is determined to continue the use of chilled wheels on the present rolling stock, and on any additions;" but we should be surprised to hear that Mr. Fell advocated for London, as he did for Sheffield, the steel-tired wheel on the score of longer life.

Assuming for a moment that the use either of steel-tired or of chilled wheels is thoroughly practicable, we believe that the only rational method of purchase is to contract for wheel-miles and not for wheels.

The wheel-miles are what we want, and we are treating the contractor lightly at our expense if we buy simply wheels. We know that wheels are very frequently sold under guarantee, but we know also that the guarantee is hardly ever enforced, while as a rule little attempt is made to ascertain the wheel-mileage. The *Street Railway and Tramway Journal* of December 19th, 1903, informs us that several large American companies are buying wheels on the above basis. "Under this contract the company pays the firm supplying the wheels a certain price per 1,000 wheel-miles. A record is kept simply of the total car-mileage of the cars of various classes . . . . and payment is made on the basis of it."

It is obviously to the advantage of the maker to turn out good wheels, while the user will not be careless, because he has to pay for changing the wheels and will see that this is done as seldom as possible.

Under such a system arguments about the relative lives and economy of steel tires and cast-iron wheels could have no place, for they would be directly comparable from the tenders.

THE BOEHM SYSTEM OF ELECTRIC LIGHTING FOR TRAINS.

This system, like the "Stone" system, obtains its supply of current primarily from a generator driven by one of the axles of the train, and consequently requires to be supplemented by a battery of accumulators, to maintain an uninterrupted service of lighting during such periods as the generator is not in operation. The chief interest of the Boehm system lies in the method employed to regulate the speed and voltage of the generator independently of how fast the train may run. This method is claimed to require only a small battery of accumulators, and to enable them to work under such favourable conditions that the cost of attention and repairs to the cells is reduced to a minimum. As is well known, the battery is the weakest and most expensive part of all such train-lighting systems, and it is most important to secure a proper charging and discharging of the cells without permitting excessive rushes of current or unnecessarily heavy overloads. Up to the present, however, despite the various methods in use, the cost of maintaining the batteries has always been very heavy, and there is great room for improvement in this respect.

In the Boehm system, the generator is driven by a train of friction pulleys, four in number. One of these is rigidly attached to the carriage axle, and another to the shaft of the generator. These two pulleys are not in contact with each other, but a space is left between them, and they are connected up by means of two movable pulleys, arranged so

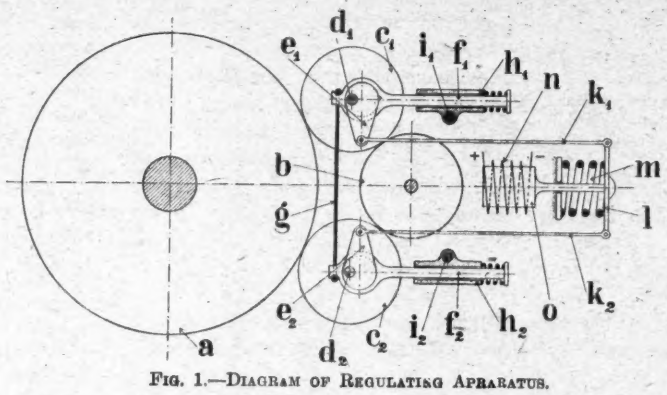


Fig. 1.—Diagram of Regulating Apparatus.

that they can be moved to press firmly against the peripheries of both the driving and the driven wheels. These idler pulleys are arranged one on each side of the other two, as shown in fig. 1, and their position and the pressure they

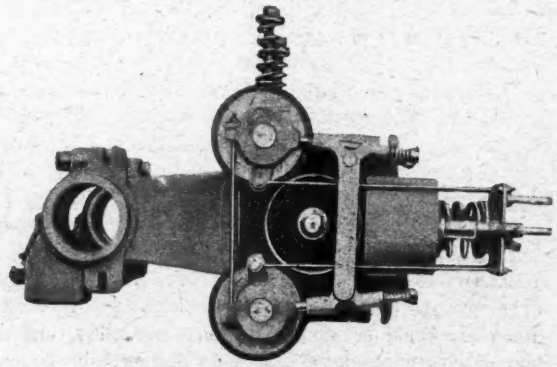


Fig. 2.—Regulating Apparatus.

exert is so regulated by an automatic electrical device that, when the speed of the axle rises above a certain predetermined amount, and thereby tends to raise the voltage of the supply unduly, the pressure of the idlers is reduced, and a certain amount of slip takes place. The method of working will be made quite clear on reference to the diagram shown in fig. 1.

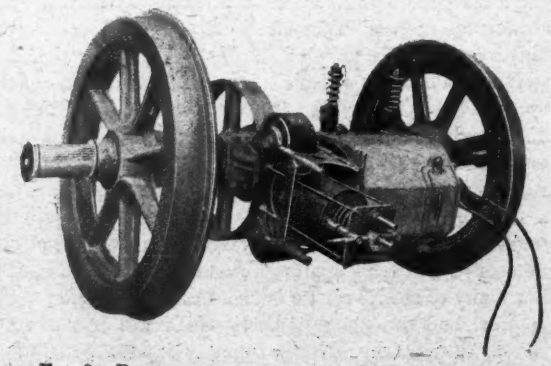


Fig. 3.—Regulating Apparatus in Position on Axle.

A is the pulley on the carriage axle and *b* the dynamo pulley. c_1 and c_2 are the two friction pulleys, rotating on axles, d_1 and d_2, fixed eccentrically in the ends of the arms f_1 and f_2. The eccentrics in the end of the last can be rotated

by means of the cranks, e_1 and e_2, and as the two rods are kept a fixed distance apart by means of the tension rod, g, any movement of the cranks tends to cause the idler pulleys either to approach or to recede from each other. The spring, m, pressing on the plate, l, draws the idlers nearer together, and presses them against the dynamo pulley and the carriage axle pulley, the method of attachment of the rods f_1 and f_2 allowing the pressure to equalise itself automatically between the two wheels. The action of this spring is resisted by an electro-magnet, n, the winding of which is arranged as a shunt to the dynamo. As the speed of the latter rises, the action of the electro-magnet becomes more and more powerful, until at a certain speed it overcomes the force of the spring, thus moving the cranks in the opposite direction, and relieving the pressure between the idlers and driving pulley. By adjusting the tension of the spring the speed can obviously be regulated so as never to exceed any predetermined amount which may be desired, and as the electro-magnet is specially designed to be very sensitive to the least change of voltage, the latter is maintained practically constant at the required limit, and will never exceed that limit, no matter how fast the train may run. It will be observed that, as the electro-magnet is arranged as a shunt across the circuit, it regulates entirely by voltage, and quite independently of the load on the machine.

When the dynamo is charging the cells, an overcharge is rendered impossible, since the voltage of the dynamo cannot

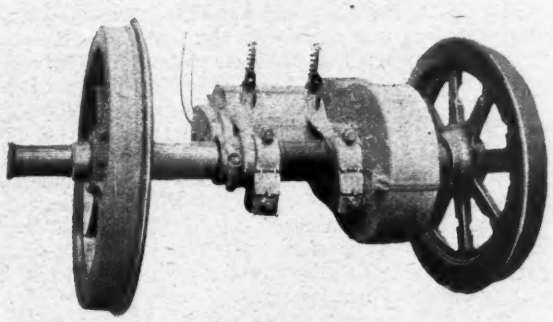


Fig. 6.—Dynamo in Position on Axle.

exceed a certain limit; as the voltage of the cells rises, the charging current gradually decreases, until it becomes nearly zero. The battery always continues to receive current until it is charged, quite independent of whether the lamps are burning or not.

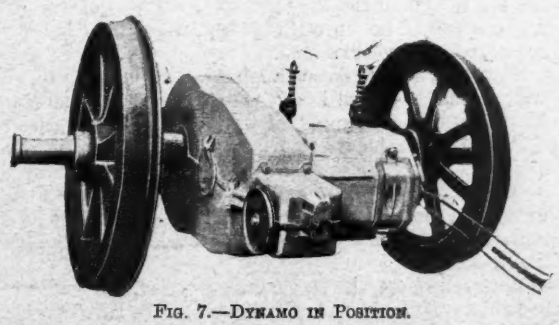


Fig. 7.—Dynamo in Position.

Fig. 2 gives a view of the regulating mechanism by itself, and fig. 3 shows it in position with the dynamo on the carriage axle.

The connections between dynamo, battery and lights, are shown diagrammatically in fig. 4. A is the dynamo and B the battery; C is an automatic electric switch, the electro-magnet of which has two windings, one in series with the main circuit, and the other a shunt across the terminals of the dynamo. This switch connects up the positive pole of

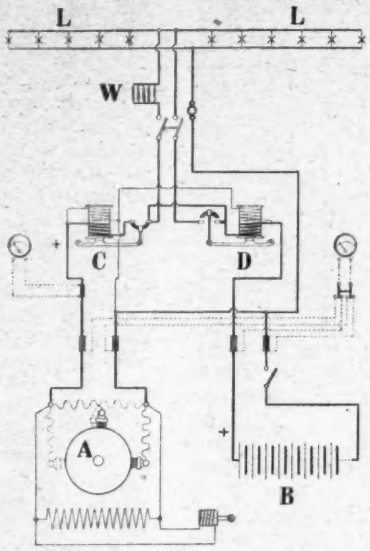


Fig. 4.—Diagram of Connections.

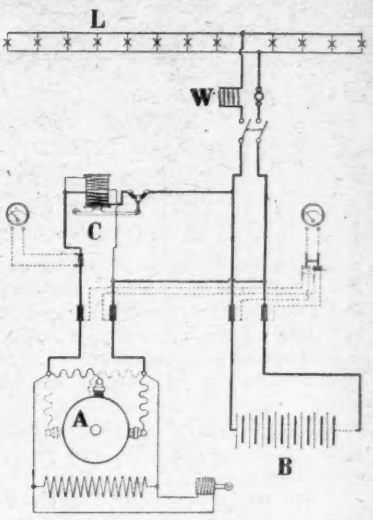


Fig. 5.—Alternative Arrangement of Connections.

the dynamo to the positive pole of the battery, and also to the lamps, when the first has run up to the speed necessary to give the proper voltage, the switch being closed by means of the shunt winding. If the voltage of the generator falls below that of the battery, the current from the latter flows round the electro-magnet in a reverse direction and opens the switch, and at the same time closes the second switch, D, thus putting the battery on to the lamp circuit. This switch is normally held open whilst the dynamo is working, by the current flowing from the latter to the battery. If the battery is on the lamp circuit, as soon as the dynamo comes up to its proper voltage it throws out the battery, and takes up the load itself, at the same time recharging the battery should the latter require it.

In order that the battery may be charged whilst the lamps are burning, the normal voltage of the dynamo is higher than that of the battery, hence a resistance, W, is inserted between the dynamo and the lamps, this resistance being adjusted so that the lamps receive the correct voltage. The battery feeds straight into the lamp circuit without any such resistance.

In fig. 5 is shown an alternative arrangement whereby the second switch, D, is dispensed with. Where this method is adopted, the current from the battery also passes through the resistance, W, which consequently has to be self-regulating to compensate for the difference in the voltage of the battery and dynamo. This arrangement requires more cells than the previous one, in order to compensate for the drop in voltage across the resistance.

When the direction of motion of the train is reversed, the brushes of the dynamo are rotated, so as to make the direction of flow of the current the same as before; thus with a four-pole machine they are shifted 90°.

During the day, or at other times when no lighting is required, the dynamo is thrown out of action by merely moving a handle, which compresses the main spring of the regulator and lifts the idler pulleys out of contact with the driving pulley on the carriage axle. This can be done while the train is running at any time, from the interior of the carriage, if it is desired to do so for inspection or regulation.

The weight of the dynamo does not rest directly on the carriage axle, as it is spring-suspended at its centre of gravity. The machine is maintained in proper position by two arms which fit round the carriage axle, and the whole mechanism is completely enclosed to keep it free from dust and water. Figs. 6 and 7 show how completely the appa-

ratus is protected. Access to the interior and to the brushes can be obtained by removing a portion of the casing.

The cut-out switch for the dynamo, with the automatic switches, fuses, instruments, &c., are arranged upon a small switchboard in the interior of the carriage. The storage battery is carried underneath the body of the coach.

SIMPLE STORIES.

By "INNOCENS."

I.—The Chief who would be Fatherly.

There dwelt in a certain city a Chief who was paid to manage a lighting station. He blessed, and cursed not; and he was well-beloved of his subordinates. At least, if any man hated him, that man held his peace, for it was judged expedient. Nevertheless, divers disputations arose among the staff, for no man had his duties defined unto him.

Now, after many days the murmuring of the inferiors rose unto the ears of the Chief, and he went down unto them, saying:—

"Why reason ye among yourselves, saying to each other, 'Do this thing, for verily it belongeth not unto me;' or else, 'Why come ye interfering with that which is my labour?' Are ye not all brethren, and am I not as a father unto you? Go ye therefore, and work peaceably one with another, for this my station shall not be made like unto a bear-garden."

And they replied unto him, saying, "Give us rules, that we work not every man against his neighbour, for lo! we have no positions assigned unto us, and we know not where we are."

And he said, "Go to! go to! Ye be contumacious! There be few of you, and ye shall work together as one family. Verily, ye should show forth an example of brotherly kindness for these other people of my station who are not so expensive unto me as ye are."

This said he, for that it was in his heart to prevent them having a position, lest haply they should ask of him more money.

But it came to pass that a charge engineer was nursing a bearing which had not been attended to, forasmuch as at least two men thought they should boss the fitter, and the fitter reasoned within himself that he could do his own bossing. Therefore the engineer had a full stream of oil on the bearing. But the Chief, passing by, beheld the flow of oil, and was sore displeased, saying, "Why this waste?" and commanding the driver forthwith to ease it off, he straightway departed out of the engine room without informing the engineer. For this was unnecessary as things were managed.

The bearing therefore got warm and ran its metal, and there was an expensive smash.

When, therefore, the Chief was called before the Council, he reported the gross inattention to detail of the charge engineer, and the Council dispensed with that gentleman's services.

Moral:—There is often trouble in the best regulated families.

II.—Vox Populi, Vox Asinorum.

In the city of Dor, in the land of Shirrsetdor, lived a Wise Man. When he spake, the people obeyed, for his words were esteemed above rubies. His judgements also were like unto those of Solomon, so that the malefactors praised him as they were thrust into prison.

Wherefore the heart of the Wise Man was lifted up, and he said within himself, "Where is there a Ruler like unto me, or where is there a city like unto this city which I have managed?" And he took a journey, to see if haply he should find a glory approaching unto the glory of the city of Dor, in the land of Shirrsetdor.

Many days did he wander, and found naught to come nigh unto the splendour of Dor, till he came unto the city of a people who had given themselves over unto curious arts. Now it was evening as he came upon that city, and the blackness of the night was on him as he entered the gates. But lo, the streets were radiant with a brightness he had never seen before; the booths, also, in the bazaar were glowing with strange light, and the people of the city laughed and sang as if there were no night. And the Wise Man was greatly moved thereat, and said: "Verily, here is a glory that doth not pertain unto the city which I have managed, and I have found a people that is wiser than I." And he straightway made inquiries what this thing might be.

When, therefore, he had sojourned in this city many days, and held converse with the Rulers thereof, he returned unto his own country with haste, and called the people together, saying:—

"Lo, I have travelled far and seen many things that ye have not seen, yet have I beheld nothing that approacheth unto the glory of this city, save in a certain city in a far land. Yet I say unto you, in that city there is no night, for the rulers of that city have made the light by night even as the light by day. Come now, therefore, let us also have this glory, that we be mighty among the peoples of this land."

And this thing pleased the people, and they rejoiced at his words, saying: "Let us even now make supplication unto the Beeotee that we may have this light." For the Beeotee were a powerful people in the land. Yet some murmured, saying: "Verily, this will cost us many shekels of silver," but they were speedily put to silence.

It came to pass therefore that the Wise Man and other Sages banded themselves together and obtained a Consulting Engineer and a Provisional Order. And the Consulting Engineer said unto them: "For 30,000 pieces of gold ye shall be glorified beyond the glory of any other city, and I will charge you but 2 per cent. for my labour among you. Nevertheless, I cannot always be with you, so that ye should take unto yourselves a Resident Engineer, who shall do all my dirty work, and ye shall pay him 120 pieces of gold in each year, and forbid him to do any other labour."

And this saying also pleased the people, and they sent forth a proclamation throughout the land for a Resident Engineer who should do as he was told. A man therefore forsook a job which was worth unto him a hundred and ninety pieces of gold per year, and came to dwell among them for the experience thereof; and the experience was very rich.

For a great murmuring arose in that city, because the people doubted the words of the Wise Man, saying: "Verily, these be travellers' tales. He is of a truth having us on. He is making a bit." So they said to the Sages: "Do not this thing, for verily we be poor, and we will not have this light among us.

The Wise Man, therefore, was wrath, and said unto them: "Wherefore then did ye entreat of me to get for you a Provisional Order and a Consulting Engineer, making me look a fool? Go to, then! Ye shall not have the glory that I have seen, but a lesser glory, and it shall cost you but 10,000 pieces of gold."

But the people cried, "Away with it! We will not have this thing!" And there was a mighty rebellion in the city, and the Wise Man and the Sages were cast out of the city. And the people set up other judges, whose thoughts were not as those of the Wise Man.

Therefore, the Resident Engineer came unto them, and said, "What now shall I do? For verily I have no work for my hands, and I know not whence I shall have meat to eat." And the judges said unto him: "That is your business! Get ye to the land whence ye came, for verily we have no use for you." And the Resident Engineer was wrath, and demanded great sums from them for Compensation; and verily they paid him what he asked, for they feared the Beeotee.

When, therefore, the people came together, they said unto one another, "Lo, we have done well! We have bought a Provisional Order that we have not used; we have paid 2 per cent. on 30,000 gold pieces for naught; we have compensated our Resident Engineer for giving him nothing to do; and we have no light. Yet it is well, for we are a free, intelligent people, and we have undoubtedly shown ourselves as wise as the Wise Man.

Moral: The better fed the ass, the stronger it kicks.

SOUTH AFRICAN NOTES.

[From our Durban Correspondent.]

Durban (Natal).—An engineer volunteer corps is in process of formation in Durban, which will embrace harbour defence and field sections, and later on a telegraph section. The corps is to be under the command of Mr. J. T. Ritchie (previously of the Natal Field Artillery) with Mr. J. Roberts, borough electrical engineer of Durban, as first lieutenant. Electricity will play an important part in the harbour defence section, and already there has been a good response from local men.

A new tramway manager has been cabled for to replace the late manager, Mr. W. D. Jeffs, whose engagement with the Durban Corporation terminated on May 16th.

Vryheid (Natal).—The town of Vryheid have under consideration an electric lighting scheme, the chief movers being the hotel proprietors there. A rough canvass of the town gives approximately 1,000 lamps as being likely to be required as a start.

Mafeking (Rhodesia).—Mr. M. Lambe, at present borough electrical engineer of Kimberley, has been appointed consulting engineer to the Mafeking Corporation, who have under consideration an electric lighting scheme.

Cape Telegraphs.—The revenue derived from telegrams in Cape Colony during March last was £19,382, a decrease of £1,605 as compared with March, 1903. The total revenue for the year up to the end of March last was £230,835, a decrease of £65,652 as compared with the previous year.

Johannesburg (Transvaal).—An urgency report of the Tramway Committee was brought forward at the Council meeting on May 11th, recommending that an additional capital expenditure of £31,458 be sanctioned for including some of the outlying suburbs in the general lighting scheme; and that an additional capital expenditure of £7,485 be sanctioned for the purpose of providing for underground instead of overhead cables in the districts recommended by the consulting engineers; further, that an additional capital expenditure of £12,640 involved in rearrangement and increasing the generating plant as recommended by the consulting engineers, be sanctioned.

King Williams Town (Cape Colony).—The death is reported from Kingwilliams Town of Mr. Bradbury, an electrician, aged 24 years, who met his death by being in a trap accident, about 5 miles out from town, on May 15th.

Pietermaritzburg (Natal).—In the Pietermaritzburg Municipal Year-book, just issued, for the year ending July 31st, 1903, statistics regarding the electricity department are given:—The result of the year's working shows a profit of £1,905 19s. 6d. after paying all capital and maintenance charges at 9 per cent.; £574 3s towards the cost of the loan flotation and contributing £750 to the maintenance of the town office staff. This profit has reduced the previous year's debit balance of £2,997 19s. 11d. to £1,092 0s. 5d. The number of new consumers connected was 194, with 4,428 8-c.p. lamps, and the increase in motor load was 68 h.p. Many additions to the plant were made, including a 120-kw. Willans-Mordey alternator, and an extra set of boilers and feed pumps. The lengths of underground mains laid were ·2 mile of h.t. cable, and 2·1 miles of l.t. cable. The total units generated were 816,750 at a total cost of 6·773d. per unit, the works cost being 3·973d.

Boxburg (Transvaal).—The Municipality of Boxburg recently called for tenders for the erection of plant, and maintaining an electricity supply for a period of four years.

South African Science Association.—A meeting of the members of the Council of the South African Science Association was held in Johannesburg on May 16th, when Mr. Reunert was granted leave of absence to visit England, where he will represent the Association at the Cambridge meeting of the British Association. It was decided to approach the various Governments of South Africa with a view to inviting the co-operation of their technical departments in compiling a handbook for special use of the British Association, who will visit South Africa next year. Resolutions from Pietermaritzburg to have a branch in the Natal capital were considered.

Another correspondent writes:—

"Recently, in the Supreme Court at Cape Town, Mr. Justice Hopley gave judgement in the action Thompson *v.* McKenzie & Co. This was a claim for the recovery of £320, balance due for an electrical lift and for sundry repairs and replacements. The defendant denied liability on the ground that the lift was never satisfactory, and was never really accepted. He counter-claimed for £1,266, £800 of which was for the cost of taking out the lift and putting in a satisfactory machine; £216 for extra expenses incurred; and £250 for damages sustained when the lift did not work satisfactorily. The Judge said: 'In cutting the amount down to £100, I am leaning, as far as I possibly can, in favour of the plaintiff, and I think that, in the circumstances, that amount will be fair and equitable to award to the plaintiffs on their counter-claim. The result, therefore, is that, of the £170 in their hands, the defendants retain £70 towards repairing the lift, which they are to retain as their property; and they are also entitled to £100 as against the damages which I have awarded to them. The plaintiff must pay the costs of the action.'"

Natal.—The Durban Corporation has installed a refrigeration and cold storage plant, the machinery for which is driven by a General Electric Co.'s motor, operated by the tramway current.

Transvaal.—Tenders have been invited by the Johannesburg Town Council for the supply of three 30-kw. and six 15-kw. transformers for the maintenance of the electrical system. It is estimated that these will cost £630.

More ground is needed in Johannesburg for the extension of the local lighting works, and it is proposed that a piece of land be transferred to the Lighting Department of the T.C., at a price of £24,000.

Port Elizabeth.—The abridged prospectus of the Corporation loan issued last week states that one of the objects of the loan is electric lighting, for which a sum of £100,000 will be required. The scheme provides for the lighting of some 61 miles of streets and roads, public buildings, as well as a supply to private consumers. At a recent meeting of the T.C., the Mayor, in commenting on the inadequacy of the local gas supply, observed that they "hoped in the course of a few months to have the electric lighting arrangements started. That would be as soon as the money market was favourable, and providing the report of the engineer was satisfactory. In the meantime (the scheme would take 18 months or two years) they would have to suffer serious disabilities."

Kroonstad.—At a special meeting of the Town Council, the subject of tenders for the generating station was brought up, and the different tenders were laid on the table. The sum originally voted for the installation was £10,000, whilst the contract price amounted to £9,274, including £1,450 allowed for the generating station, which the Council decided to build on their own account, and thus give the work locally. The total amount at the disposal of the Council was £2,176. All the tenders were, however, in excess of £1,450, and Councillor Hoseason said he was inclined to fall in with Councillor Wessels' idea, and ask for fresh tenders for a very much plainer building. Councillor Wessels moved: "That seeing the tenders for the generating station exceeded the sum of £1,450 set aside by the Council, all the tenders be thrown out, and that fresh tenders be asked on fresh plans and specifications, and that Mr. Saunders, the consulting engineer, be informed to this effect, and asked to draw up fresh plans and specifications." The motion was agreed to.

Cape Town.—Mr. Wm. Thorne, the Mayor, recently presided at the presentation of a portrait in water colours of Mr. D. McDonald, the superintendent of tramways. A number of citizens associated themselves with the officials of the Tramways Co. in subscribing towards the cost of the gift.

At a recent meeting of the Harbour Board a letter was read from Mr. Thompson, master of the sailing ship *Orari*, acknowledging the splendid dispatch obtained by his vessel at the docks. Mr. Herbert remarked that the quick discharge of this vessel showed the advantage of the new electric cranes.

CONDENSATION FALLACIES AND FACTS.

By W. H. BOOTH.

The excellence of a vacuum appears to be considered too much as a matter of the quantity of water sent through the condenser, if this is of the surface variety. This is because the arrangement of a surface condenser is usually of an entirely promiscuous nature. A surface condenser has a large number of tubes all equally supplied with water, and steam flows across these tubes equally in contact with their colder and warmer extremities. It would appear more rational to enclose the middle length of the tubes in a jacket fitting closely round the bundle of tubes and compel the steam to effect an entrance to the bundle and travel longitudinally along the spaces between the tubes, emerging at the other end by a very much narrower uncovered band to the air pump. The water should flow along the tubes in a direction counter to the flow of the steam outside them.

The amount of water necessary for condensing a pound of steam can be calculated very simply and directly. Assuming that the water has a temperature of 50° F., and that it is desired to leave at 105° F., there is a gain of 55° F., or a trifle above 55 thermal units per lb.

The steam contains about 1,178 thermal units per lb., and if it leaves as water at 55° F., it loses 1,123 units. Then 1,123 ÷ 55 is nearly 21. Therefore, with a properly designed condenser, the conditions named demand only 21 times the feed for condensation. If the passage to the air pump along which the air flows could be made to traverse tubes filled with the water flowing to the condenser, the bulk of the air might be reduced, and the vacuum improved somewhat. This supposes the dry air pump, or a separation between the water discharge and the air discharge. The excellence of a vacuum ought to be determined by the temperature of the effluent water, and this, in a counter current condenser, should be a little warmer than the entering circulation water. Ordinarily, the condensed steam is as hot as, or hotter than, the circulation discharge. Thus, instead of 55° F., it would have a temperature of 105° F. The relative vacua at these two temperatures are 29½ and 27½, a difference of 2 in., or 0·86 of a pound pressure. The temperature of the water marks the limit of the vacuum that can be obtained, but it is very doubtful, under even the best practicable conditions, if so good a vacuum as 29½ can be got. The air in the condenser, like any other gas, has a volume proportionate to the absolute pressure reciprocal. At 27½ in. vacuum, the absolute pressure is 1·189 lbs. per sq. in. At 29½ in. it is only 0·207 of a pound. The volume is thus nearly sixfold, and to maintain such a vacuum, the volume generated by the air pump would need to be multiplied by six.

This is, of course, the reason why the Parsons turbine condenser is fitted with a steam jet, the object of which is to gather air at extreme tenuity, and force it towards the air pump at a somewhat greater density, in order that the air pump may bite off a greater weight per stroke than it can when only drawing on an air space at 29½ vacuum. Let us see what is the relation between air and air pump. Each cb. in. of free air, or atmospheric air, which gets into the boiler or the engine, or the exhaust pipe, expands to 70 times its volume at 29½-in. vacuum. Reduced to air pump dimensions, this means that an air pump, 13½ in. diameter, with a stroke of 1 ft., would only deal with about 25 cb. in. of air, or about two-thirds of a pint measure, whereas the same pump on a 27½ in. vacuum would deal with half a gallon. It is to reduce this half gallon into the two-thirds of a pint that the steam jet is employed. Its effective pressure to do this must be such as to overcome a resistance of 1 lb. per sq. in. It is not to be overlooked that this steam jet must be at once killed, or it would spread back into the vacuous space and vitiate the intensity of the vacuum. An air pump bucket can only extract at each stroke its own generated volume of air, and this must be greater than the volume to which all the inleaking air expands. If this be not the case, the vacuum will fall off until the air density is so much greater that the pump can get hold of as much weight per stroke as leaks in during a stroke period. A very small difference of vacuum makes a very great difference in the capacity of the air pump to deal with it. The repeated use of the same feed water should cause very little air to find its way into boilers, and air, in a condenser, is in such cases almost wholly a matter of leakage at glands. Better vacua years ago were obtained than are usual to-day. One reason was the use of fibrous packings on low pressure glands, and there is nothing to-day to prevent the same being employed on low pressure or vacuum glands, for these are no hotter than they were when steam of 30 lbs. pressure was let into the cylinder. Another cause of air leakage is the long exhaust pipe to the condenser, carelessly jointed, and there are leakages through the valves which shut off the exhaust branches of each engine, not to mention other sources of air. These faults are what render the independent condensing plant so unsatisfactory in practice, because, instead of hunting up air leakages, the air pump is over-driven to conceal them.

The steam intensifier of the Parsons condenser is really a form of compound compressor, the steam jet representing the first cylinder of the compressor and the ordinary pump representing the second cylinder. The whole combination is, of course, simply an air compressor, compressing to one atmosphere. The steam jet takes the place of the extra large first cylinders which it is necessary to use on the Rand, where the air at 6,000 ft. elevation is of too low a density to provide weight sufficient in the ordinary sizes of machine used nearer sea level.

In a condenser the water demands a low temperature, or it will produce vapour to choke the air pump, and the air demands a large air pump to deal with it at high vacua. Hence the need for counter current condensers for one purpose, and supplementary air condensers to cope with highly expanded air.

THE GERMAN ASSOCIATION OF ELECTRICITY WORKS.

The members of the Vereinigung der Electricitätswerke assembled in large numbers at the opening of the three days' conference which was commenced at Strasburg on May 30th, under the presidency of Herr Uppenborn, of Munich. International in character, the meeting of the Association was attended by representatives of works in Austria-Hungary, Holland, Switzerland, Denmark and Sweden, and Profs. Hagen and Feussner were present on behalf of the German Reichsanstalt. During the transaction of formal business, it was mentioned that the capital expenditure of the works connected with the Association amounted to £25,000,000.

Herr Uppenborn, chairman of the Electro-technical Committee, submitted a report on the Prussian Bill, which was referred to in the Review on April 1st, relating to the cost of testing and supervising electrical installations, steam drums, lifts, and other "dangerous appliances." He stated that a great defect of the Bill was the omission of regulations with regard to the manner in which electrical installations are to be carried out so as to form the basis of a test. A further disadvantage arose from the fact that, in addition to Prussia, the Governments of Bavaria and Saxony were preparing Bills in a similar direction, and thus the danger existed of the introduction of an extraordinary legal uncertainty in the area of the German Federated States. At the suggestion of the Committee, the conference resolved to approach the Imperial authorities with a request for the adoption of uniform regulations for the whole of Germany.

The question of promoting legislation for the compulsory appropriation of sites for the erection of electricity works was next discussed. It has been found to be exceedingly disadvantageous not to be able to make sure of acquiring suitable land for this purpose, and a special committee appointed by the Association has elaborated a Bill which proposes to authorise the compulsory purchase of desirable property. It was decided to proceed further in the matter in conjunction with the Union of German Electrical Engineers.

The attitude of the Continental Incandescent Lamp Syndicate, as represented by the Berlin sales bureau of the united glow lamp works, was then taken into consideration. It was pointed out that the entire glow lamp industry had been consolidated in the form of a trade syndicate. Admissions were frankly made that, prior to the establishment of the combination, the prices of glow lamps were too low, and it was submitted that no one would have objected to a moderate increase in quotations. But dissatisfaction was expressed with the manner in which the question was handled at the present time, on the ground that the quality of the lamps supplied by the syndicate in no way fulfils the conditions which are essential in the interests of consumers. It was eventually decided to appoint a committee to enter into further negotiations with the syndicate and to report on the question at the next conference.

The proceedings on the second day were almost entirely devoted to the discussion of a report relating to the introduction of an official test for electricity meters in Germany. At the previous year's conference the Association expressed the opinion that the time had not arrived for the institution of an official standard, and this view was endorsed at the recent assembly, which at the same time gave approval to suggestions for improvements being made in electricity meters. Dr. Hagen, President of the Reichsanstalt, and Dr. Feussner, of the same Institution, participated in the discussion, and intimated the manner in which the Imperial authorities proposed to deal with the law respecting electrical units.

The conference was brought to a close on the third day by a discussion of the equipment and working of central stations, and Breslau was selected as the locality for the next general assembly of the Association.

PARLIAMENTARY.

Swindon Corporation Bill.

This Bill came before Mr. J. W. Wilson's Select Committee of the House of Commons on June 7th and 8th. The Bill contained a number of proposals with regard to the Corporation's electrical undertaking and also certain lines of tramways, &c. The promoters were represented by Mr. Gerald Fitzgerald.

Mr. Fitzgerald addressed the Committee with regard to the electrical proposals. He said that in 1895, the Corporation's predecessors, the Newton Urban District Council, obtained an order authorising electric lighting within their district. In 1900 the charter was granted to the Corporation, and the electric lighting undertaking was vested in the Corporation, with a provision in the charter that the powers of the order of 1895 should extend throughout the borough, so that the undertaking became vested in the Corporation for the benefit of the borough. In 1903 the Corporation began to supply. That part of the Bill was opposed by the Swindon Gas Co., who were allowed a clause on grounds of competition under Standing Order 129, which allowed a *locus* to be granted. The opposition was directed to two clauses, the extension of the area of supply, on which of course they were entitled to be heard, and the clause which sought power to supply electric fittings. They also asked in the petition for a provision which was practically the Bermondsey clause. It might be doubtful, continued counsel, whether their limited *locus* covered that part of the Bill. Dealing with the first clause, counsel explained that the Corporation sought to extend the limits so as to make the electric lighting limits co-extensive with their water limits by including with the area of supply, the Parish of Wroughton, with a population of 2,448; Rodbourne Cheney, with a population of 1,639; and Stretton St. Margaret, with a population of 3,367. They were all suburban parishes of Swindon and were within the water limits of the Corporation, and the limits of the gas company. They had reason to believe that there would be a demand for lighting, which they would be in a good position to supply, as they would not require any new generating station. At the present moment the gas company had a monopoly of those districts, and the gist of their opposition was to be found in paragraph 7 of their petition. They alleged, in short, that the extension of the electric lighting powers to those districts could not be remunerative, and that they (the gas company) would be compelled, if it were not remunerative, to contribute towards the maintenance of the undertaking. As to the prospect of the extension, the Corporation started with 40 consumers, taking an equivalent of 4,700 8-c.p. lamps, and that was only last year. On March 31st of this year they were supplying 181 consumers, taking an equivalent of 9,521 8-c.p. lamps, and the manager of the department had application from two power consumers who would take 20,000 units between them, and one consumer who would take 20,000 units for lighting, 12 who would have an equivalent of 960 lamps, and there were 30 new houses, built or now in course of erection in the *existing* area. The estimate for the year ending March 31st, 1905, showed an estimated surplus of £263 They would charge 2½d. per unit from September next until the following March. With regard to the merits of extending the electric supply to populous villages, the Committee would be aware that electric light was more healthy than gas in small houses.

The Chairman: You are not going to argue that you will put the light into artizans' dwellings?—Mr. Fitzgerald: Most decidedly. He would bring a witness to show that they hoped to do that.

The Chairman: I should be glad to hear of any place where it has been done.

Counsel then dealt with the rateable value of the houses in Swindon and the neighbouring district, and passed on to the question of competition with the gas company, contending that the supplying of fittings was the road to success. With regard to the

Bermondsey clause, he called the attention of the Committee to what had been done in the Leyton case, and said that the Board of Trade had uniformly opposed the clause.

Mr. John G. Griffin, electrical engineer and tramway manager to the Corporation, was then called. He stated that he was of opinion there would be a large demand for the light, and thought that as local authority the Corporation had a good chance of supplying other friendly local authorities. None of the parishes was large enough to have an electric supply station of its own. Going into details, he said that while there might be some slight increase in plant, there would be no need for additional buildings or boilers. The capital cost per KW. for establishing the generating plant would be less than £20. The average all over the kingdom was £25 for plant and station. Most of the inhabitants of the districts proposed to be supplied worked in Swindon. With regard to the small houses, builders did not generally put in gas fittings, but left it to the tenants, so that a number of houses were without gas fittings. They were frequently told that if people could get wired upon that scheme they would take the light.

The Chairman: But the clause does not include wiring at all?—Not on behalf of the Corporation. The Corporation would have power to instruct the wiring contractors to wire premises themselves, and obtain from the customers the cost of wiring over a number of years.

Mr. Fitzgerald said that the clause was perhaps somewhat ambiguous. The intention was to prevent the Corporation doing the work themselves, but they could give the right to contractors. He suggested that in that and all future clauses it would be better to put in "by their own agents or servants."

The Witness said that the clause complied with what the electrical trade wanted. He was further examined, and said that the present charges for electrical power were as follow:—5d. per unit for lighting purposes, or, as an alternative, 2d. per unit plus a capital charge at the rate of £7 10s. per kilowatt, prices being subject to the following discount: For the consumption of 10,000 Board of Trade units per annum, 5 per cent.; 15,000, 10 per cent.; 20,000, 15 per cent. For power purchase the charge was 2½d per. unit, with practically 1 per cent. per 1,000 discount.

Cross-examined by Mr. Shiress Will, K.C.: Witness did not know how many of the tenants of the smaller houses were weekly tenants.

Witness having been re-examined, the Chairman of the Committee said that they did not feel that there was any case for extension of area at present. They did not give thatidecision solely on the opposition of the gas company, as they had come to that conclusion before they heard that opposition. They were not disposed to put the provisions of the Bermondsey clause upon the Corporation, but they were disposed to give them the fittings clause.

Mr. Shiress Will desired to address the Committee on the fittings clauses, and the Committee agreed to this, and having heard him,

The Chairman asked Mr. Boyce, who represented the Local Government Board, if he knew of any case in which the fittings clause had been given purely for fittings without free wiring. Mr. Boyce could not answer the question off-hand.

After further discussion of the matter between the Committee and the various counsel, it was decided by the Chairman that the clause to be adopted was clause 9 of the Willesden Bill.

The tramway proposals were next considered. There were four new lines proposed. There were about 8 miles of tramways authorised, of which 3 miles 3 furlongs would be opened in September. The principal new route proposed was along Princes Street—from the town hall to the railway station. There was also a proposal to run motor omnibuses in connection with tramways. Witnesses having been called, the Committee decided to sanction the tramways, but refused the powers sought with regard to the running of the motor omnibuses. The remaining clauses were then adjusted.

Manchester Corporation Tramways.

The Tramway Bill of the Manchester Corporation was considered by a House of Lords Committee, of which Lord Hawkesbury is chairman, on Friday. The promoters' case was opened by Mr. Balfour Browne, K.C.

Mr. D. Boyle, the chairman of the Tramways Committee of the Corporation, said that the tramways included short lengths in Parker Street and George Street, a line a mile and a half long from Rochdale Road, through Victoria Avenue to Middleton Road, and several other shorter tramways.

Mr. T. De Courcy Meade, the City surveyor, and other witnesses were called in support.—The Committee then adjourned.

Torquay Tramway Bill.

The Bill promoted by the Dolter Electric Traction Co. for the construction of tramways on their system in Torquay came before a Select Committee of the House of Lords, presided over by Lord Hawkesbury, on Friday last week.

The promoters were represented by the Hon. J. D. Fitzgerald, K.C., and Mr. Vesey Knox.

In opening the case the Hon. J. D. Fitzgerald said that the Bill had already passed a Committee of the House of Commons. The proposals contained in the Bill were as follow:—A tramway from Tor Station through one of the principal streets of the town to the Harbour; a tramway from Torquay Station to the Tor Station; and a tramway from the Harbour to join the two other lines. The Town Council had passed a resolution in favour of the scheme, which was now opposed only by some local residents.

Mr. Hugh Neville Lubbock, the chairman of the promoting company, was the first witness called. He stated that the capital of the company was £100,000.

Mr. W. C. C. Hawtayne, the consulting engineer to the company, said that he had inspected the route of the proposed tramways and saw no difficulties in the way of construction. The total length of the lines in single track was 14 miles, the total route miles being slightly under nine. The gauge of the tramways would be 3 ft. 6 in. The sharpest curve was one of 40 ft. radius, and the steepest gradient one of 1 in 10, for a distance of 3 chains. Witness handed in diagrams explanatory of the Dolter system of traction. A longitudinal section showed three studs in the paving, and a cross-section showed a double line of tramway with two studs in cross-section. In the contact box was a cylinder of an insulating material containing the switch-gear, which consisted of a sort of bell-crank lever, attached to the top of the contact box, and swinging freely. On the car itself there were two skates, which formed the pole feeder of the electro-magnet. As the car travelled along, the skate would come over one of the contact boxes, the lever would be attracted, and the circuit closed. The skate was always over two studs, so that it was always deriving energy from one or the other. As the skate left a stud, the latter part of the skate tended to force away the contact piece, and so leave the stud absolutely dead. If, from any cause, the contact-piece was not forced away, and the stud was not absolutely dead, the safety skate which trailed behind the other, came over the contact piece, and short-circuited the block, by making a connection between the stud and the rail, and so cut the stud out of action. The system had been at work for two years in the Bois de Boulogne in Paris, and no accidents had occurred.

Mr. J. E. Waller, engineer, was also called; and a number of local witnesses spoke as to the advantages of the scheme.

On Tuesday, after hearing evidence on both sides, the Committee found the preamble of the Bill proved.

Preston and Blackburn Tramways Bill.

A Select Committee of the House of Commons, presided over by Sir Edward Strachey, had this Bill under consideration on Tuesday.

The case for the promoters, the Preston and Blackburn Tramway Co., was opened by Mr. Balfour Browne, K.C. The scheme was to construct a tramway between Preston and Blackburn, 6 miles 4 furlongs in length, of which 5 miles 1 furlong would be single line and 1 mile 3 furlongs double line. The double line would commence in New Hall Lane, Preston, and passing in an easterly direction over and along Brockholes Brow, Brockholes Bridge, and Preston New Road, would terminate in the last-named road in Blackburn at its intersection with Beridge Road. All the local authorities were in favour of the Bill, and the only opposition came from the Lancashire and Yorkshire Railway, on grounds of competition. Dealing with this petition, Mr. Balfour Browne said that at no point would the tramway be within two miles of the railway line, so that the two routes would serve totally different districts. The promoters also sought, by the Bill, to take certain lands in the parish of Samlesbury for the erection of a generating station. The capital of the company would be £130,000, with borrowing powers not exceeding £32,500.

A number of local witnesses were called in support of the measure, and Mr. Griffiths, one of the promoters, gave financial evidence.

After deliberating in private, the Committee found the preamble of the Bill proved.

Tramway Provisional Orders Bill (*No.* 1).—On June 9th the Examiners found that Standing Orders had been complied with in respect of the above Bill, which deals with orders granted by the Board of Trade in respect of the following:—Altrincham U.D.C. tramways; Calverley U.D.C. tramways; Crompton U.D.C. tramways; Plymouth Corporation additional tramways; Rochdale Corporation additional tramways; Royton U.D.C. tramways; Wardle U.D.C. tramways.

Leyton Tramways Bill.—At the resumed consideration of this Bill, to which extended reference was made on p. 945-6 of our last issue, the Chairman, after hearing further evidence, said that the Committee had considered the question very carefully. In regard to the Bermondsey clause, there were two points which were raised by it. The first was that which required the local authority (in this case the District Council) to make estimates at the beginning of its financial year of its receipts and expenditure on the electric lighting undertaking. The Committee would have considered whether that part of the clause should have been put into the Bill if they had not been told that it was now done, and would be continued. In regard to the second point as to charging any loss which their estimates might show in the year upon the undertaking, the Committee unanimously refused to place that obligation on the Council. As to the supply of electric lighting to outside districts, they decided that it should be given. With regard to the wiring clause, it did not give any power to wire. The clauses were then adjusted.

Preston, Chorley and Horwich Tramways.—A Select Committee of the House of Commons, under the chairmanship of Sir E. Strachey, considered the above Bill on Friday and Monday. The object of the Bill is to authorise the company to construct a new road and deviation of tramways, and to abandon a portion of a tramway authorised by the Companies Act of 1903, in the Station Road Walton-le-Dale. Power is also taken to raise £100,000 additional capital. It was explained that last session the promoters obtained

powers to construct a tramway connecting Wigan with Preston by way of Bamber Bridge. They now wish to abandon the line from Bamber Bridge to Preston, and to adopt an alternative route *vid* Tostock Hall. The reason for the proposed alternative route was the opposition on the part of the Walton-le-Dale District Council to the carrying of the public road over the Lancashire and Yorkshire Railway at Bamber Bridge by means of a proposed bridge. The Bill was opposed by the Lancashire and Yorkshire Railway Co., and Sir R. Littler, K.C., who represented the railway company, said the promoters had deliberately broken the bargain which they entered into last year with the railway company. When the promoters' Bill was considered last session, it was opposed by the Lancashire and Yorkshire Railway Co. on the ground of competition, but his clients were induced to withdraw their opposition on the promoters agreeing to construct a bridge at Bamber Bridge to take the place of the present level crossing. By the present proposals, the railway company would be equally affected by the competition, but would get no compensation in the shape of a bridge to take the place of the level crossing. After hearing evidence, the Committee declared the preamble of the Bill proved.

Electric Lighting Provisional Orders Bill (*No.* 4).—On Thursday, June 9th, the Examiners of Standing Orders found that the necessary conditions had been complied with in the case of the Electric Lighting Provisional Order Bill (No. 4), which relates to orders granted by the Board of Trade to the following:—Ashford and District Electric Supply Co., Ltd.; H. Foote, L. Milne, and E. J. Owen, trading as the Southern District Electricity Corporation, for part of the Urban District of Ely, Cambridgeshire; Twickenham and Teddington Electric Supply Co., Ltd., in respect of the Urban District of Ham, Surrey; E. P. Harvey, of Riverdale House, Richmond, Surrey, in respect of the Urban District of Hexham and the Parishes of Acomb, Sandhoe, Hexham, West Quarter, and Warden, in the County of Northumberland; M. H. Bennett, of the Chestnuts, Horley, in respect of the Parish of Horley, Surrey; Keynsham Electric Light and Power Co., Ltd., in respect of the Parishes of Keynsham and Saltford, Somerset; to the Kingswood Electric Supply Co., with respect to the Urban District of Kingswood, Gloucester; Urban Electric Supply Co., in respect of part of the Urban District of Newton Abbot; Teignmouth Urban District Council, amending the order of 1899 so as to allow a transfer of the order to Messrs. Crompton & Co., Ltd.; order granted to the Urban Electric Supply Co. in respect of the Urban District of Walton-on-Thames.

Tyneside Tramways and Tramroads Bill.—On Thursday, June 9th, Mr. Le Rossignol was further examined. He said that anyone wishing to go from Newcastle to North Shields would go by means of the railway, which would soon be electrified. Mr. McElroy, the general manager of the Manchester Corporation Tramways, gave evidence as to the practice of running powers in that city. On Friday, Mr. Honoratus Lloyd addressed the Committee on behalf of the opposition, and Mr. Balfour Browne replied. The Committee unanimously decided to grant the powers asked for, and found the preamble of the Bill proved, subject to the omission of the clause relating to facilities for the interchange of passengers.

Metropolitan District Railway Bill.—On June 9th Mr. Parker Smith presided over the Court of Referees to consider, amongst other matters, the objection of the Metropolitan District Railway Co., the Fulham Borough Council being heard in opposition to the company's Bill. Mr. W. H. Dickinson, who appeared for the Borough Council, said the company's Bill failed to make provision for the running of workmen's trains, and also limited the amount of personal luggage a passenger should be allowed to have carried. He contended that the ratepayers of Fulham would be deprived of existing rights by the Bill, and that therefore they should be allowed to be heard before the Committee. Mr. C. Munro, for the District Co., submitted that there was no precedent for allowing such a body as the Fulham Corporation to be heard on the question of rates and fares. He pointed out that the company was going to make the experiment of uniform fares, and while there might be an increase on present rates for some small journeys, yet the bulk of the fares would be reduced, and of course the people of Fulham would share in the reduction. The Court decided to allow the Borough Council to appear before the Committee, but limited their opposition to Clause 32 of the Bill.

Electric Lighting Provisional Orders (*No.* 5) *Bill.*—On June 9th the Examiner found that Standing Orders had been complied with in respect of the above Bill referring to the following Scotch provisional orders granted by the Board of Trade:—National Electric Construction Co., Ltd., Burgh of Musselburgh; Portpatrick Electric Supply Co., Ltd., in respect of part of the Parish of Portpatrick; local authority in respect of the Burgh of Wishaw.

Petitions.—The following petitions have been deposited in respect of private Bills:—From J. B. Parkinson against dispensing with the Standing Order No. 128 in the case of the petition of the South Lancashire Tramways Co. against the Lancashire Electric Power Bill; by Messrs. Martin & Leslie against dispensing with the same Standing Order in the case of the petition of the Chiswick U.D.C. against the Metropolitan District Railway Bill. The Edinburgh and District Tramways Co. are petitioning against the Leith Corporation Tramways Order Confirmation Bill, and the Chiswick U.D.C. against the Metropolitan District Railway Bill. The Great Western Railway Co. and the London and North-Western Railway Co. have withdrawn their opposition to the Metropolitan Railway Co.'s Bill.

Bristol Tramways (*Extension*) *Bill.*—The announcement is made that the opposition to this Bill has been withdrawn, and accordingly it will go before the Unopposed Bill Committee.

Opposition to Electric Lighting Orders.—Petitions in opposition to No. 6 Electric Light Provisional Order Bill have been deposited in the Private Bill Office of the House of Lords by the Wilts County Council against the confirmation orders to the Trowbridge, Bradford-on-Avon Urban, and Bradford-on-Avon Rural orders.

Tramway Orders Opposed.—The following tramway confirmation orders in the Tramways Orders (No. 2) Bill are being opposed:—The Bishop Auckland, Shildon and Spennymoor order, by the North-Eastern Railway Co.; the Ossett Corporation order, by the Great Northern Railway Co. and the Yorkshire Electric Power Co.; and the Dewsbury Corporation order, by the Great Northern Railway Co. and the Yorkshire Electric Power Co.

Harrow Road and Paddington Tramways Bill.—On Tuesday the Unopposed Bill Committee of the House of Lords, under the Chairmanship of Lord Balfour, considered the above Bill, which authorises the company to widen and alter roads, and to sell the undertaking to the Metropolitan Electric Tramways Co. Formal evidence was given in support of the preamble, but the Committee postponed its decision for certain minor matters to be settled.

It is reported by the House of Lords that all opposition has been withdrawn, and the Bill has been committed.

ENGINEERING STANDARDS COMMITTEE AND TRAMWAY POLES.

The conference of tramway pole makers, convened by the Sub-Committee on Electric Tramways, and referred to in our issue of May 13th, took place recently at the Institution of Civil Engineers. The conference appears to have been a most successful one, and the following gentlemen were present:—

Mr. A. P. Trotter (chairman); Mr. Forbes Higginson; Mr. J. H. Rider; Mr. H. M. Sayers; Mr. R. H. Scotter; Mr. A. M. Sillar; Mr. J. J. Steinitz; Mr. A. H. Walton; Mr. Frank Herbert (Stewarts & Lloyds, Ltd.); Mr. W. James Higgs (James Russell & Sons, Ltd.); Mr. L. L. Robbins (National Tube Co., Ltd.); Mr. T. Harris Spencer (John Spencer, Ltd.); Mr. A. C. Williams (British Mannesmann Tube Co., Ltd.); Mr. Leslie S. Robertson (secretary); Mr. C. Le Maistre (electrical assistant secretary).

The chairman, in opening the proceedings, drew the attention of those present to the position of affairs with regard to the proposed standardisation of three-section tramway poles. He remarked that the sub-Committee had commenced work upon this problem early last autumn, since which time a large amount of valuable and interesting information had been gathered by correspondence. In the first place a circular dealing with tramway pole details had been drafted and forwarded to the manufacturers for their consideration. The replies had been collated in tabular form, and the Committee had held several meetings to carefully consider this information. As the result of their deliberations, a further circular had been drafted, in which certain proposals were made for standardising three-section tramway poles, as far as possible embodying the views of the Committee and those of the manufacturers. This circular was forthwith issued to a large number of tramway engineers in the kingdom. Some time necessarily elapsed before the replies could be all received and collated, but the *résumé* which was ultimately laid before the members evidenced the fact that a large majority of the users were in favour of the suggestions put forward. The Sub-committee then proceeded to draft a standard specification for three-section tramway poles with the aid of the evidence and information which they had now gathered. Before, however, finally adopting this specification, it was thought advisable that the makers should have a further opportunity of considering the recommendations of the Committee, and of making any final criticisms they might desire. With this object in view, the proposed specification was issued confidentially to the makers, and as the replies were not entirely in accord with the proposals, this conference had been decided upon.

A list of questions which was to form the basis for the discussion at the conference, had previously been circulated to the members, and these were taken *seriatim* by the chairman.

The classification and the overall length of poles, as well as the length of telescope joints which were proposed by the Committee, were agreed to by all present.

A discussion took place with reference to the lengths of the sections proposed as standard, and some of the members were in favour of a slight alteration being made on the score of economy suggesting that the two top sections should be made of equal length. The Committee has proposed certain figures for the outside diameters of the poles, which were chosen with due regard to interchangeability, and so forth. The witnesses were, however, not altogether in favour of the figures proposed, as, in their opinion, these would not represent the most economical pole which could be produced to stand the stipulated bending tests. A long discussion ensued resulting in a definite proposal being made to increase the suggested diameters by an even amount. This important proposal, we are informed, is now receiving the very careful consideration of the Committee. The proposals as to standardising similar diameters and overall lengths for both sectional and taper poles, as well as making the bases interchangeable, was, on account of its obvious desirability, carefully gone into.

Questions relating to the proposed drop test bending and permanent set tests, as well as many other practical details with regard to standardisation of tramway poles, were discussed at length with gratifying results.

In bringing the conference to a close, the chairman tendered the thanks of the Committee to those present for their attendance at

the conference and for the courteous manner in which they had placed their information at the disposal of the Committee. He hoped that, with the help of the information already supplied and the personal views of the makers before them, the Committee would be enabled to revise their proposed standard specification in such a manner as to meet the views and serve the best interests of all concerned.

LEGAL.

J. H. Holmes & Co. *v.* J. White & Co.

Mr. Justice Channell, sitting with a special jury in the King's Bench Division on June 9th, heard this action, in which plaintiffs claimed £300 for goods sold and delivered, and work and labour done, for the defendants in connection with the installation of electric light on the ss. *Frascati*. The defendants' case was, that there was a clause in the contract that plaintiffs should give the installation a trial lasting five consecutive hours, but they had never done so.—The jury found that the defendants had accepted and used the installation.—Judgement for plaintiffs, with costs.

Davis *v.* J. G. White & Co., Ltd.

In the City of London Court, on 10th inst., Mrs. Davis, the wife of a Cricklewood greengrocer, sued J. G. White & Co, Ltd., contractors, College Hill, E.C., for £50 damages for having been poisoned by coal gas. We gather from the *Times* summary of the case that the Middlesex County Council last year began laying a light railway through High Street, Cricklewood, where the plaintiff helped her husband in his shop. The Willesden U.D.C. decided to have the roadway repaved, and the defendants were given both contracts. The plaintiff's case was, that the defendants' men did their work so badly that they punctured 42 gas pipes in 600 yards. The gas escaped, and while the plaintiff was standing outside her shop she swallowed so much gas that she became unconscious. She was ill for a long time, and she now demanded compensation. The defendants denied that their men were careless, and they said the repairs were done as soon as possible.—The jury found for the plaintiff for £15, and costs were given on the higher scale on account of the public importance of the case.

Wharton *v.* Yorkshire (Woollen District) Electric Tramways, Ltd.

At the Dewsbury County Court last Friday, plaintiff, Sarah Emma Wharton, widow, sued the Yorkshire (Woollen District) Electric Tramways, Ltd., for £281 7s. 8d. for damages for injuries sustained in consequence of the alleged negligent driving of a car by one of the company's servants. On January 1st plaintiff was crossing the road when she was knocked down by an electric car running from Ravensthorpe to Dewsbury. The driver stated that he was only travelling at the rate of four miles an hour. He spoke to plaintiff after the accident, and told her she ought to look out when she crossed a road, and she replied to the effect that she must have lost her head.—The case was adjourned.

Electro-Neurotone Co., Ltd., *v.* Dubois and Williams.

This case came before Mr. Justice Grantham and a special jury, in the King's Bench Division on Friday last. It was an action by the company against the defendants, a firm of solicitors, for damages for alleged misrepresentation and breach of contract. Defendants, by their defence, denied that there was any breach of contract on their part, or that they made any of the alleged misrepresentations.

Mr. Montague Lush, K.C., Mr. Simmons, and Mr. Ernest Wetton, were counsel for the plaintiffs, and Mr. Rawlinson, K.C., and Mr. Wilkinson, appeared for the defendants.

Mr. Lush, in opening, said the action was brought by the company to recover damages against the defendants for not making good an undertaking which they gave to plaintiffs under circumstances which he would mention. The plaintiffs were the owners of some valuable patent rights in an electrical apparatus, which was being largely used now by many persons of distinction, which was in the nature of an electrical battery. The company was formed and incorporated with a small capital for the purpose of carrying on business in the sale of these articles. There were four directors, viz, Messrs. Bailey, Hedges, F. G. Lloyd, and Hodgkinson. Another person who was concerned was a Mr. Thomas, of Messrs. Thomas & Co. Thomas, counsel understood, was a company promoter, and in the years 1902-3 was desirous of buying the business and goodwill of the plaintiff company and selling it to a new company with a much larger capital, who would be able to make a much larger business of it. Negotiations proceeded, and Thomas's scheme was that he would carry this thing through by way of reconstruction. What Thomas wanted to do was to buy all the shares from the shareholders except the seven required as subscribers under the Act, and then bring out the new company, which he wanted to be called by the same name with the addition of the word "parent." In order to carry out that plan it was necessary for the plaintiff company to wind itself up and go into liquidation. Thomas instructed the defendants to act as his solicitors in the matter, and they did act. The scheme went to this length that the shareholders of the plaintiff company executed transfers of their shares in favour of Thomas, but inasmuch as it was not certain that the scheme would go through Thomas executed retransfers back. An actual arrangement was entered into in August, 1902.

Mr. Rawlinson, interposing, said his defence was that his clients simply acted as solicitors for clients throughout, and not personally at all.

Mr. Lush, continuing, said that at a meeting held on June 19th, Mr. Williams, one of the defendants, was present, and said in reply to a question by Mr. Campion, that he would undertake the registration of the new company at the request of Mr. Graham Lloyd as soon as possible, and that he had the money. The company went into liquidation, and in liquidation it had remained, and defendants had never registered the company.

Mr. Rawlinson said there was a direct conflict of evidence on the question of the undertaking.

After hearing evidence, his Lordship said he had no doubt that Mr. Williams had made himself personally liable to pay the money to register the company, and he would have to pay to put the company back in its old position.

Mr. Rawlinson said he wished to call evidence on the point, and the hearing was then adjourned.

On Monday, when the hearing was resumed, Mr. A. E. Williams denied that he gave any personal undertaking on behalf of his firm to the plaintiff company. His firm had no interest in the matter except as solicitors.

Evidence was given to the effect that the cost of restoring the company to its original position would be £160.

In the result the jury returned a verdict for the plaintiff company for £100. Judgement was given accordingly.

National Electric Traction Co., Ltd.—Petition of Consolidated London Properties, Ltd.

This matter was before Mr. Justice Buckley in the Companies' Winding-up Court on Tuesday, when counsel stated that the debt of the petitioners had been satisfied, as well as that of another creditor supporting the petition.

His Lordship accordingly dismissed the petition.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Disputed Results from a Refuse Destructor.

In your issue of May 27th I notice in a letter which appeared from a director of Meldrum Bros., Ltd., that "as much as 15,000 lbs. of steam has been produced from *one* Lancashire boiler in an hour, this boiler being 30 ft. × 8 ft., and fired by unscreened refuse alone." Now this seemed to me rather extraordinary, for I have never seen a test made with coal as fuel which has given such a result, and never read of one before either. As I thought my memory might be misleading me, I have looked up several authenticated tests, but cannot find any results approaching the remarkable results mentioned above, even when fired with coal. Perhaps you would oblige by giving some results obtained with coal as fuel.

Unbelieving Thomas.

June 8th, 1904.

Fault Tests for Submarine Cables.

I shall feel much obliged to any of your readers who can give me the following information:—

1. When and where was the Blavier fault test first applied and described? Who was M. Blavier?

2. When and where was the "Cromwell Varley Loop" fault test first applied and described?

3. Where can I find a description of McGill's fault test?

4. When and where was the "false zero" method of balancing the resistance of a cable traversed by earth currents first applied and described?

I remember trying the "false zero" method on the Western and Brazilian Co.'s cables in the end of 1874, but I cannot find any description of it in any of the 37 "B.A. Reports on Electrical Standards, 1862—67," reprinted in 1873 by E. and F. Spon, or in Culley's "Handbook of Practical Telegraphy," 1874 edition, or in Latimer Clark and Robert Sabine's "Electrical Tables and Formulæ of 1871," or any other book prior to any of these dates.

E

I am anxious to record the dates and the origin of "Submarine Cable Fault Tests" in the next or 17th edition of "Munro and Jamieson's Pocket Book of Electrical Rules and Tables."

I have just re-read the late Prof. Fleeming Jenkin's Cantor Lectures on "Submarine Telegraphy," delivered before the Royal Society of Arts on January 29th, 1866. Both Blavier's formula and Varley's loop test are described there, as well as Murray's loop. Mr. John Murray, of Glasgow, first tried his test on board the *Niagara* during the first (or 1857) Atlantic cable expedition.

Andrew Jamieson.

16, Rosslyn Terrace,
Kelvinside, Glasgow,
June 10*th*, 1904.

Condensation in Conduits.

I notice in your very friendly criticism in the current issue of the REVIEW, you refer to me as having forgotten about the air inside the conduit.

This, however, is not the case, as I find with the temperature changes in ordinary life, and taking into account the ratio of horizontal to vertical conduit, &c., in general use, that this circulation of air must be extremely small. For instance, taking as an extreme case, a conduit 100 ft. long, of which 25 is vertical, assuming free air circulation, and a 4° F. difference of temperature, the velocity is only 0·72 ft. per second; and if there is one sq. in. of section for air in the conduit, this is only 18 cb. ft. per hour. In reality, bends, and all sorts of obstructions meet the air, so that this value will be much reduced.

Even with free access of air, this quantity seems negligible compared with what must impinge on the outside of conduit when exposed, with ordinary ventilation, 3 ft. per second being quite a common velocity.

Since, then, the quantity of moisture is a very small percentage of the air impinging on conduit, I conclude the correct way to regard condensation is as indicated in the article.

Also with regard to conduits buried in mortar, they appear to me to be less subject to temperature fluctuations and action of moist air, so condensation should be less in this case.

The Writer of the Article.

Atavism.

Among his other very excellent qualities, our friend Mr. Booth possesses in a marked degree the sense of humour, and an unbounded enthusiasm. Enthusiasm is so rare a virtue that one can forgive much in the man who possesses it, and even misplaced zeal has sufficient of the soul of goodness in it to merit pardon. The spectacle of a man so fired with enthusiasm that even "his coat tails reached ignition temperature" was surely a sight for the gods. Let *us*, therefore, not blame him.

Most of the very entertaining matter in Mr. Booth's letter (and Mr. Booth is always entertaining as well as instructive) bears neither on the article to which I alluded, nor on my remarks, and the opinions he seeks to attribute to me are his own, not mine. *Hinc illæ lachrymæ.*

I must plead guilty to an intense loyalty to my own profession, but this does not imply that I see no faults in electrical practice. I may think the Briton the best fellow in the world, and the Lancastrian second to none, but I am not necessarily, therefore, blind to the faults of either. I once heard a street hawker crying "stinking fish"; he was probably perfectly honest, but he was nevertheless a traitor to his trade. When I write articles booming gas-light, I shall put myself on his level. "The less said about contaminated atmosphere the better for 'F. B.'s' lauded tube." It is not my tube, nor did I laud it. But I will say this for it, that the contaminated atmosphere is due to "gas" and not to electricity. Besides, it was Mr. Booth who raised the point about contaminated atmosphere.

Mr. Booth concludes by saying that there are systems twice or thrice as economical as the Welsbach, of which I appear to know nothing. The reference to Welsbach was a quotation from Mr. Booth's article, notwithstanding his triple note of exclamation, and I am well content—yea, even "placidly content"—to leave the booming of the others to gasmen.

Mr. Booth thinks my paraphrasing of his remarks unfortunate. But, seeing that my object was but to accentuate his meaning, I seem to have been singularly successful, as Mr. Booth agrees absolutely with my rendering of them.

I agree entirely that the worst kind of atavism is "going backwards," but fail utterly to find in Mr. Booth's article that it was against this that he raised his voice. Surely, going back to gas is not progress! No, sir; in advocating a return to gas, our friend is leading a forlorn hope, and I could not possibly satirise his attitude so forcibly as he himself does when he likens himself to the shipwrecked sailors, who, "in the absence of a capacity for other means of grace," made a collection. It goes very much against my inclinations to take part in any controversy of this kind, as it was indelibly impressed upon me by an old employer "to avoid ink-slinging," and, having entered my feeble protest, I have done. Much less would I desire to follow my friend into his prayer meeting. Should I have the temerity to do so, 'twould be to plead that his exceptional talents and boundless enthusiasm might be diverted from the bye-paths of atavism and gas to the highway of electrical progress and light.

F. B.

Tramway Management.

In answer to the letter signed by "Assistant Manager," I may state that I am not either personally or professionally prejudiced either for or against the employers or the employed. My letter was written as a note of warning or enlightenment. I still maintain that a "split turn" day is wrong in principle, unfair and unjust. I maintain that the fundamental principle which leads to successful management is "harmonious" relations between the employers and the employed, and unless such relations do exist there can be no approach towards "ideal" conditions.

It is only a matter of time before a "common-sense" working day with good wages will be adopted, either by "amicable" arrangement or undesirable conditions. "Assistant Manager" is certainly very lucky if he can get *competent* motormen at a short notice, for it is only a few months ago since a large Corporation were advertising in at least a dozen papers throughout Great Britain for motormen; the strike lasted several weeks and they did not get the men. Times have changed since "Assistant Manager" had his strike experiences, because the organisation is now only just beginning to gain strength.

Wm. R. Bowker.

I read with some interest the letter in your issue of the 27th ult., and the reply of the 3rd inst., relative to tramway troubles. I am afraid your correspondent Mr. Bowker has based his argument upon wrong premises, and the tenor of his communication rather leads one to think he is not entirely unbiassed, and he certainly speaks with either want of knowledge as to the actual working conditions, or he is not placing the issue fairly before your readers, if, indeed, there is any issue at all.

The writer has had some little experience of tramway work extending into the teens of years, and therefore can claim some little knowledge upon the subject of which he is writing.

Your correspondent makes an attempt to elevate the tramway motorman into a very much more exalted position than circumstances warrant. Now, what are the true facts? Take the whole body of motormen and conductors in the kingdom, and you will find that they are in the majority of instances derelicts from almost every class of employment.

There is no technical knowledge required to make a man a motorman, and, in fact, some of the best motormen to-day are ex-soldiers, for the simple reason that they are men who have been used to discipline, and can usually be depended upon to keep their heads fairly cool.

When I use the word "derelict," I can imagine my Union friends gnashing their teeth and suggesting I am lowering the general body of tramway employés, but such is, however, not the case. A man may be for various reasons, over which he has no control, unable to earn a living at a trade, to learn which

he has, perhaps, spent five or seven years' apprenticeship, and, as a consequence, he drifts into tramway work where, in the course of a very short time, probably a month or six weeks at the outside (and even less if he is of average intelligence), he can earn a comfortable living, and in my experience which is with a fairly large tramway, the supply of men far exceeds the demand by probably 100 to 1, and is it to be wondered at, considering that with such little training as is necessary, men who would otherwise have to work as labourers at labourers' rate of pay, should be only too anxious to rush in and fill the vacancy where they can almost immediately earn 25s. to 35s. per week of approximately, say, 60 hours, without hard labour, and I believe in most cases based upon a day of 10 hours.

Just a word or two upon the "split turns," about which such a cry is being made. Probably the majority of your readers do not understand what the meaning of this may be. At certain hours of the day the traffic requires additional cars to run above the normal services. Such additional cars may not be required, at certain periods, for more than two or three hours, say in the morning, and again for a little longer period in the evening.

Is it reasonable, fair or equitable to the employers of labour, whether they be a corporation committee, spending the ratepayers' money, or whether it be the board of directors of a company, to ask them to pay men, who are already fairly paid for their labour, for a large additional amount of time for which they do not work?

I think the position is altogether untenable, and the sooner the men, whom Mr. Bowker seems to have such a knowledge of, begin to know on which side their bread is buttered, the better it will be for themselves.

I should very much doubt the accuracy of Mr. Bowker's statement as to some managers having dozens of men on the staff, paid, waiting in the event of a strike, and should think he is only referring to spare men who are kept to take the place of those who miss their turns, or who may be away from work for various causes.

Another Manager.

Municipal Appointments.

As one who has recently escaped from such a municipal muddle as "Don't" so aptly describes in your last issue, I shall feel grateful if you will allow me to add a few words to his complaint.

The nauseating manner in which party likes and dislikes are brought into prominence in municipal undertakings, and the consequent chronic state of disaffection that prevails amongst the staff, is surely answerable in a great measure for their indifferent success.

I do not think it is too much to say that the rotten system of intrigue pervading such works renders the life of a straightforward engineer a burden. The worst faults of private enterprise are found magnified and cloaked in the canting phrases so dear to the average councillor. The "hunt with the hounds, run with the hare" policy, of necessity adopted by the chief engineer who would keep his place, makes appeal to him worse than useless. I think this is the experience of "Don't," myself, and a host of others who apparently lack the ability to crawl.

Once Bitten, Twice Shy.

INFORMATION WANTED.—Mr. J. L. Brown, of 64, High Street, Sheffield, writes:—"I should be glad if you could assist me, through the medium of your journal, to get one or two addresses of firms supplying model high-speed hot-air or gas engines, cheap grade, from about a $\frac{1}{16}$ to $\frac{3}{4}$ H.P., for driving model dynamos."

"INQUIRER" writes:—"I should be glad if any of your readers could kindly inform me of the name and address of the makers or suppliers of the small dry cells about $1\frac{1}{2}$ in. × 1 in. × $\frac{1}{4}$ in. thick which were on the market about 10 years ago, and if they are still obtainable."

THE GILBERT TERCENTENARY.

SATURDAY last was a never-to-be-forgotten day in the annals of the historic town of Colchester, and in the proceedings of the Institution of Electrical Engineers. It was better than the annual Oyster Feast, although we cannot speak of this from personal experience. We once heard of a man, however, who, being assured that the consumption of Colchester natives increased the appetite, declared, after swallowing eight dozen, that he felt no more hungry than when he started! Be this as it may, those who were invited to spend the day in Colchester were afforded an intellectual treat, although they missed the succulent bivalve!

Some seven months ago the Institution, through its President and Council (see the ELECTRICAL REVIEW for December 18th, 1903, pp. 973 and 1005) presented to the ancient East Anglian borough an historical picture, painted by Mr. A. Ackland Hunt, and exhibited in Manchester so long ago as 1876, of William Gilbert demonstrating electrical experiments before Queen Elizabeth and members of her Court, the group including Drake and Raleigh. Saturday was made the occasion of its formal reception and unveiling, and various other interesting ceremonies in connection with Dr. William Gilbert, physician to Elizabeth and James I., author of "De Magnete," and the father of electrical science.

The visitors travelling from London to take part in the tercentenary commemoration included Mr. Robert Kaye Gray, the President of the Institution; Messrs. J. E. Kingsbury and W. H. Patchell, Vice-Presidents; Mr. S. Dobson, member of Council, and Mr. Lloyd, the secretary; Profs. Ayrton, Perry, J. D. Everett, Fergusson (who had travelled from Scotland to be present); Dr. Silvanus P. Thompson, Dr. Larmor, Dr. Walmsley, Mr. Martin Roberts and Mr. Probert, of the G.P.O., Mr. Conrad Cooke (one of the secretaries of the Gilbert Club), members of the Press, and others.

The party left Liverpool Street Station at 10 a.m., arriving at Colchester at 11.20. From the station they were driven to the Town Hall, where the Mayor received his guests. Light refreshments having been served in the Mayor's parlour, the assemblage walked to "Tymperleys" (Dr. Gilbert's birthplace), and afterwards to Holy Trinity Church, where he is buried, and where the monument erected to his memory was dilated upon by Dr. Thompson. A visit was paid to the electricity works, presided over by Mr. A. R. Sillar, the borough electrical engineer; to St. Botolph's Priory and to the Castle, and then an adjournment was made for a most *recherché* luncheon in the Moot Hall, served in excellent style.

After honouring the loyal toasts, the Mayor, in a very appropriate and happily-turned speech, desired the company to join with him in a silent toast to the memory of Colchester's great citizen. He next extended to the visitors a cordial welcome to the town, and after Mr. Gray had returned thanks to the Mayor and Corporation, for the right royal way in which they had received their guests, seconded by Prof. Perry, in his well-known humorous vein, an excursion, lasting some two and a half hours, was made through the country which Constable loved so well for its landscapes, a halt being made at Dedham for the visitors to inspect the church.

On returning to the Town Hall a reception was held in the Mayor's parlour and then the unveiling ceremony was charmingly performed by the Mayoress, amid great applause. Mr. Gray followed with a little act as spontaneous as it was graceful; the gift of a handsome neck chain to the lady as a memento of the event and as a "chain of office!"

Prof. Thompson next delivered an interesting address, describing the progress that had been made in discoveries concerning the great scientist. Having expressed the pleasure it gave him to find in Colchester itself such recognition of the merits of the man on whose behalf he and others had worked for 14 or 15 years, he said in 1889 there was not a single line of Gilbert's handwriting known, but in the year 1895 he turned up at the Record Office a medical certificate containing a signature of Dr. Gilbert, and since then four others had been found in the books of St. John's College, Cambridge; another was found on the title page of

an Aristotle, and two more had since been discovered. It had also come to his knowledge that the last volume of the Cecil Papers contained a letter by Gilbert, dated 1599. It was a report concerning the health of the Countess of Derby, who was suffering from a Tertian ague. Of this letter the Professor produced a photograph, adding that he would present a permanent copy to the town of Colchester. He appealed for the co-operation of all East Anglians who cherished the memory of Gilbert to set on foot a systematic search in the parish records of East Anglia. He felt also certain that if the records in Colchester Castle were carefully searched, they would give further facts concerning Gilbert and his family.

Dr. E. L. Fenn then asked the Mayor, on behalf of the borough, to accept an interesting relic of Gilbert—an important document connected with the great man. It was a fortunate thing that, in the early part of this year, he happened, in turning over a box of papers, to come across a document signed and sealed by Gilbert, which, he hoped, would be kept in the Town Hall as long as it should last.

The Deputy-Mayor thanked Dr. Fenn on behalf of the Corporation and the town for this kind gift. He understood this document would be exhibited on one side of the commemoration picture, and the photograph promised by Prof. Thompson on the other.

Prof. John Fergusson, who, it was explained, had left Scotland the previous day in order to be present at this function, moved a vote of thanks to the Mayor and Mayoress of Colchester for the conduct of the business of a most enjoyable day, in which the visitors had seen a number of interesting things. He had the honour of being introduced to Gilbert by his old professor, now Lord Kelvin, long ago, and from that day he began "collecting" Gilbert. He believed that a copy of "De Magnete," which he had procured for one shilling, was now worth ninety guineas. He paid a tribute to the devotion shown by Prof. Silvanus Thompson in elucidating interesting facts regarding Gilbert.

Alderman C. E. Egerton-Green, in seconding, said the Mayor had thrown his heart into the conduct of all the varied ceremonies during a day whose success was largely due to his initiative and energy—a tribute with which we are in cordial accord.

The vote of thanks was carried by acclamation, and the Mayor, in responding, promised each of the visitors a photograph of "Tymperleys."

The proceedings, which had been graced by the presence of many ladies, then closed, and the visitors returned to town by the 7.2 p.m. train.

A notable feature of the day's doings was the clockwork regularity with which they were carried out, a fact on which the Mayor and Council are to be heartily congratulated. Not even the great railway which serves the Eastern Counties, and which holds the record amongst British lines for punctuality, could have kept more exact time. We noticed one hat, and only one, which, we suppose, was the nearest modern approach to the Gilbertian head-gear of a bygone age. It was a cross between a Trilby, a sky pilot's, and a Dick Turpin hat, but it possessed only two corners instead of three. The remainder of the party, with few exceptions, slaves to habit, wore tall hats, and tall hats are an abomination—except for taking off to ladies!

The day was dull and rather cheerless, and even the ultramarine tie worn by one of the guests failed to give that exhilarating effect to the drive through Constable's country which a gleam of sunshine would have produced.

The English translation of the "De Magnete" of Dr. William Gilbert, prepared by a committee of the Gilbert Club, from the famous and rare original folio Latin edition of 1600, was completed in 1900.

The work of revision for the press has devolved mainly upon Dr. Silvanus P. Thompson, and the Rev. W. C. Howell, M.A. Our estimation of Dr. Thompson's labour of love was expressed in our eulogy of Gilbert, published in the issue of the REVIEW, to which we have already referred, in the following words:—"We cannot conclude this brief appreciation without expressing our indebtedness to Gilbert's biographer, Prof. S. P. Thompson, whose pleasure it has been to gather together the scanty records of his life, and to embody the fruits of his labours in pamphlets in a style worthy of the subject and the author." The ceremonial of last Saturday was a worthy recognition at the hands of the accredited representatives of English electrical science of the extraordinary attainments of Dr. Gilbert, and to honour his memory is to honour ourselves.

BUSINESS NOTES.

Electrical Wares Exported.

WEEK ENDING JUNE 16TH, 1903.

Adelaide	Value £199
Amsterdam	65
Auckland	53
Bahia. Teleg. cable	9,623
Bombay	101
Buenos Ayres	172
Calcutta	650
Cape Town	412
Channel Islands	375
Durban	305
East London	246
Fremantle	108
Halifax. Teleg. cable	5,070
Hamburg	40
" Teleg. mat.	120
Hong Kong	214
Kobe	48
Madras	178
North Sea. Teleg. cable	5,953
Otago	235
Paris. Elec. machinery	880
Pernambuco. Teleg. cable	4,202
Perth	34
Port Elizabeth	382
Rockhampton	78
Shanghai	125
Singapore	54
Stettin	56
Sydney	55
Victoria, B.C.	500
Yokohama	800
Total	£30,863

WEEK ENDING JUNE 14TH, 1904.

Alexandria	Value £100
Amsterdam	176
Bangkok	164
" Elec. machinery	90
Bombay	478
Brisbane	121
Buenos Ayres. Elec. stm. crane	1,250
" Teleph. cable	360
Calcutta	386
Cape Town	24
Christchurch	54
Colombo	14
" Elec. machinery	149
Copenhagen	67
Durban	502
East London	815
" Elec. machinery	180
Fremantle	212
" Elec. machinery	35
Gibraltar	83
Hamburg	154
Hobart	68
Hong Kong	55
Iquique	24
Karachi	23
Libau	32
Lisbon. Teleph. mat.	70
Madras	15
" Elec. machinery	288
Melbourne. Elec. machinery	106
Otago	632
Perth	289
Port Elizabeth	1,496
Rio Janeiro	353
" Teleg. mat.	157
St. Petersburg	233
Santos	30
Sekondi	65
Shanghai. Teleg. mat.	52
Singapore	60
Sydney	1,376
" Elec. machinery	938
Total	£11,716

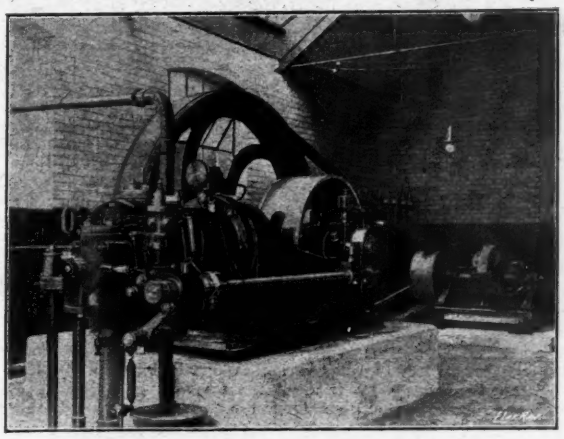
Foreign Goods Transhipped.

Cape Town. Elec. apprts.	Value 133
East London. Elec. mat.	121
Otago. Teleg. apparatus	747
Total	£1,001

English-made Telephones at St. Louis.—The Consolidated Electrical Co., Ltd., which, as the old Consolidated Telephone Construction and Maintenance Co., has been manufacturing telephonic apparatus in this country for over 20 years, and has made periodical changes in its factories and their *locale*, in order to keep abreast of the times, and to manufacture economically, is among the few British electrical firms who have thought it worth while to be represented at the St. Louis International Exhibition. We do not doubt that the company will gain in prestige from being represented at a show which, during the course of this year, will be visited by many thousands of possible customers from Europe and other foreign parts. The Exhibition is an event of great interest from an electrical point of view, and its importance becomes greatly increased by reason of the many electrical and engineering conventions which are to be held there during the next few months. The Consolidated Co. has sent us a copy of a neat and handy leaflet which it has prepared for distribution at the Exhibition. It contains illustrations of the company's various feeder panels, fuseboards, main and other switches, also circuit-breakers, and exchange and wall patterns of telephones and telephone switchboards, as supplied to British and Colonial Governments. Some of these special lines were shown in the ELECTRICAL REVIEW for November 13th, 1903. We have also received a full detailed list of the actual apparatus which is placed on exhibition by the company. It includes numerous apparatus such as have been supplied to the British Post Office, the War Office, the Admiralty, *i.e.*, relays, lightning arresters, transmitters, condensers, change-over switches, linesman's detectors, anti-shock receivers, portable apparatus as used in the Navy; also long-distance telephones of different patterns, as used for railway work on the South-Eastern, Great Central, Midland, and other railway systems. The automatic inter-communication instruments, of which we gave an illustrated description in our issue of November 6th, 1903, are also represented. Apart from telephonic apparatus, there are many specimens of Consolidated work in switches, circuit-breakers, switchboard panels, fuse and distribution boards, and so on, but our available space does not permit of mentioning these in detail.

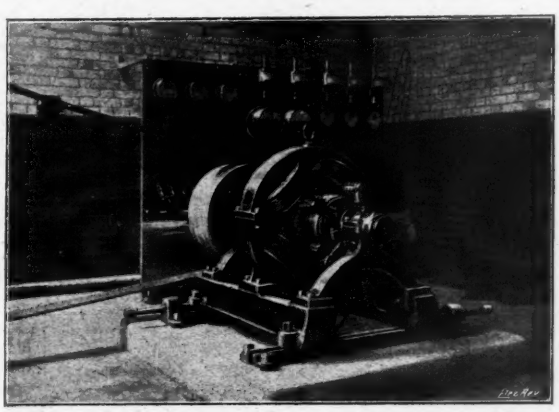
Book Notices.—"Subject List of Works on Electricity, Magnetism and Electrotechnics in the Library of the Patent Office." London: Darling & Son. Price 6d.

The Electrical Plant at Croydon Polytechnic.—We give herewith a couple of views illustrating the new generating plant which has been installed at the Croydon Polytechnic for



National Gas Engine at Croydon Polytechnic.

lighting the premises and for experimental work. The plant comprises a 40-H.P. National gas engine of the makers' latest type, with a maximum pressure of 400 lbs. per sq. in. on working stroke, necessitating a 3-ton fly-wheel. The engine has magneto ignition, and it drives, by means of a belt, a Mather & Platt 20-KW. double-current dynamo giving 230 volts continuous or alternating. The



M. & P. Double-Current Dynamo at Croydon Polytechnic.

combined plant has a guaranteed efficiency of 26 cb. ft. of gas per KW.-hour. We understand that the silencer fitted to the exhaust is especially good in its action, a faint puff from the pipe being the only indication that the engine is running. The installation of the plant was superintended by Mr. Minsbridge.

A Cape Colony Contract.—Messrs. Mather & Platt, Ltd., have just been awarded by the Admiralty the complete contract for the whole of the plant to be erected at the Dockyard, Simon's Bay, Cape Colony, for supplying electricity for lighting and power. The contract covers:—

1. Two boilers of Babcock & Wilcox's make, each capable of evaporating 8,000 lbs. of water per hour, and working at a pressure of 160 lbs., together with feed pumps and all the piping.
2. Two steam dynamos, each set comprising a two-crank compound double-acting engine, by Browett-Lindley, direct coupled to a Mather & Platt 200-KW. multipolar shunt-wound dynamo, to give this output at any pressure from 250 volts to 220 volts, and to carry 25 per cent. overload.
3. A surface condenser, with steam-driven air-pump and motor-driven circulating pump.
4. Overhead travelling crane.
5. Storage battery of 500 ampere-hours capacity.
6. Booster for charging the above battery.
7. Two portable motor-generators, to convert the 220-volt current to any pressure between 80 and 110 volts for use on ship circuits.
8. Switchboard with two dynamo panels, battery panel, motor panel, and six feeder panels, all mounted with necessary instruments, switches, and fuses.
9. A large number of motors for the workshops, varying in power from 5 B.H.P. to 50 B.H.P., together with starters, all connections, testing instruments, &c.

Trade with Egypt.—Any of our readers who may be interested in trade with Egypt can obtain information in connection therewith through the British Chamber of Commerce of Egypt by applying to the office of the *Egyptian Gazette*, 36, New Broad Street, London, E.C., where particulars will gladly be afforded to those thinking of opening up a trade in Egypt. The imports into Egypt in 1903 show an increase of two millions over those of 1902.

British Electric Car Co.—The adjourned meeting of creditors of the British Electric Car Co., Ltd. (in liquidation), was held at Manchester on 8th inst., Mr. T. F. Wild (liquidator) presiding. The *Manchester Courier* says, in reference to the matter, that at a meeting held in January last the following resolution was passed:—

That in the opinion of this meeting the Receiver and manager of this estate be requested, in the interests of the creditors, to negotiate for the sale of the business as a going concern on such a basis as may be agreed between him and the members of the committee of creditors.

Following the January meeting, the business of the company has been continued by the Receiver and manager, and the statement of accounts showed that this trading had resulted in a profit of some £500, and, having regard to the fact that various onerous contracts existed at the date of his appointment, it was thought that the result was not unsatisfactory. The chairman stated at last week's meeting that efforts had been made to sell the business as a going concern, but without success, and it was at last thought that the general body of creditors should have an opportunity of meeting the committee and himself to discuss what should be done in the future. They had carried on the trading at a small profit. Several suggestions were made with a view of continuing the business. One of the members of the committee thought that a syndicate might be formed, and the business carried on under new management. There was, however, the question of providing a working capital which stood in the way of making an accelerated move in that direction. The following resolution was agreed to:—

That, having heard the reports of the liquidator and the committee of creditors, this meeting resolves that the matter remain in the hands of such committee, with the request that they formulate a scheme for the purchase of the business, and ascertain, by way of letter, the willingness or otherwise of the creditors to subscribe thereto, and, if sufficient support be not obtained, the scheme be abandoned.

New Form of Double-Beat Valve.—An exceedingly neat device for double-beat valves is contained in the Green valve supplied by Messrs. Holden & Brooke, of Manchester. The ordinary double-beat valve consists of two valves rigidly attached and supposed to seat themselves simultaneously on two seatings. One valve opens against, and the other opens with, the pressure. Much trouble is experienced with these valves, for the body becomes distorted, and the two valves will not seat either together or squarely upon their distorted seats. To obviate this the new valve is made with separate valves and spindles. Each spindle passes out through a gland in one of the end covers, and outside the body it terminates in a head jointed to a lever. One lever has its fulcrum between the valve and the point where power is applied. In the other the valve rod and fulcrum change their relative positions. In each the fulcrum is a pair of short links jointed to the lever, and upon the cover flange. At the extreme end of the levers are jointed nuts, which engage with right and left-handed screws on a common handle rod. By turning the hand-wheel the lever ends are approached to each other, or recede, and by virtue of the type of levers, the valves both move the same way together. The seating of one valve may, of course, occur before the other, but both must become equally seated at the same pressure so far as regards the power applied, and as both valves may be free to swivel on their spindle, the seating is regular and even. Many of the faults of the double-beat valve are thus quite removed, for there are only two fixed points, and one valve can only reach its seat firmly by the reaction of the other upon its seat. Either valve can be ground in without consideration of the other one, and this is a great improvement in itself.

Henley's New Works.—Plans of extensive new works to be erected at Northfleet by Henley's Telegraph Works Co., Ltd., have been passed by the U.D.C. The works will be 700 ft. long by 140 ft. wide.

The Printing Trades Exhibition.—We are informed that the following awards have been granted for electric motors shown at this Exhibition, which was held recently at Islington:—

Silver Medal and First-class Certificate.—Electromotors, Ltd., Openshaw, Manchester.
Bronze Medal and First-class Certificate.—J. H. Holmes & Co., Newcastle-on-Tyne.
Bronze Medals.—Electromotor and Dynamo Co., London, and H. F. Joel, London.

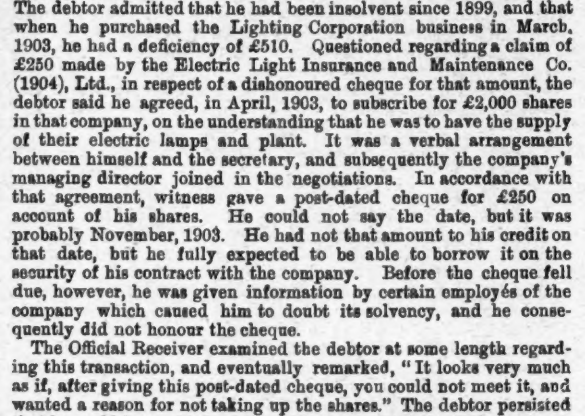
Private Telephone Installations.—Messrs. Stegmann and Co., of Clapham, have just completed six outdoor telephone installations at Castle Cary, Somerset, some of which extend for miles along country roads, and are mostly pole work. They have also installed an intercommunication system, connecting the whole of the extensive candle works of Messrs. Price & Co., Ltd., at Battersea, and have put in additional telephonic extensions at the Wandsworth and Clapham Union.

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court, held on June 9th, before Mr. Registrar Hope, C. M. Downie, electrical engineer, 4, Bloomsbury Street, and 15, Dyott Street, W.C., trading as the Lighting Corporation, attended for public examination, upon accounts showing total liabilities, £1,827 (unsecured, £1,435), and net assets £388, after deducting £142 for the preferential claims. In the course of his examination by E. L. Hough, senior Official Receiver, the debtor stated that from February, 1897 to 1899, he and Mr. F. G. W. Adams carried on business in partnership as suppliers of electric lamps and accessories, for the greater part of the period at 24, Newman Street, Oxford Street, W. In September, 1899, Mr. Adams was made bankrupt, and the partnership liabilities amounted to £450; witness subsequently paid £325, and had not since been called upon to pay the remainder. From October, 1900, to March, 1903, he was successively employed to manage two companies, the last being the Lighting

Corporation, Ltd., which concern in the latter month passed into the hands of Mr. Singleton, as Receiver acting for the debenture holders. In March, 1903, witness purchased from the Receiver the goodwill of the company's business, together with its stock-in-trade, effects, and leases for £750 (which he paid with borrowed money), and relinquished a claim against the company for £400 commission. The purchase was not actually completed until last January, the business in the meantime being carried on by Mr. Singleton on witness's behalf. Since January witness had continued the business at both addresses under the style of the Lighting Corporation. There was no partnership deed between him and the lenders of the £750 in connection with that or any other business. Whilst Mr. Singleton carried on the business, accounts were kept, showing that the payments exceeded receipts by £806, but new book debts were created, and new stock purchased, so it did not follow that a loss was made on the 1903 trading. In order to pay that £806 to Mr. Singleton, witness sold for £650 the lease of 4, Bloomsbury Street, and 5, Charlotte Mews, adjoining. He attributed his failure to the non-fulfilment of promises by certain persons to provide capital for the business, to a loss of about £1,000 on the partnership with Mr. Adams, to want of capital, to bad debts, and to loss on the trading. The two last-named items accounted for nearly £500. The debtor admitted that he had been insolvent since 1899, and that when he purchased the Lighting Corporation business in March, 1903, he had a deficiency of £510. Questioned regarding a claim of £250 made by the Electric Light Insurance and Maintenance Co. (1904), Ltd., in respect of a dishonoured cheque for that amount, the debtor said he agreed, in April, 1903, to subscribe for £2,000 shares in that company, on the understanding that he was to have the supply of their electric lamps and plant. It was a verbal arrangement between himself and the secretary, and subsequently the company's managing director joined in the negotiations. In accordance with that agreement, witness gave a post-dated cheque for £250 on account of his shares. He could not say the date, but it was probably November, 1903. He had not that amount to his credit on that date, but he fully expected to be able to borrow it on the security of his contract with the company. Before the cheque fell due, however, he was given information by certain employés of the company which caused him to doubt its solvency, and he consequently did not honour the cheque.

The Official Receiver examined the debtor at some length regarding this transaction, and eventually remarked, "It looks very much as if, after giving this post-dated cheque, you could not meet it, and wanted a reason for not taking up the shares." The debtor persisted that he could have obtained the £250 on the security of the contract, but did not do so because of his doubts of the company's solvency. The household furniture at his residence was the property of his wife, who had a private income. This was witness's first failure. After some further questions by creditors, the examination was ordered to be concluded.

Earthing Device.—In connection with the correspondence which has recently appeared in our columns, and our leading article of last week, on the subject of steel conduit for electric wiring, &c., Messrs. A. J. Beaumont & Co., of 16, Stonegate, York, have sent us particulars of their safety apparatus and earthing device, which combines house service cut-outs, main switch and earthing device. The apparatus consists of a slate or porcelain base, on which are fitted terminals for the street cables, and on one side terminals for meter (if desired). It is fitted with a D.P. main switch and a fuse on each pole, also terminals for the house cable, and the earthing terminal in the centre, to which the conduit should



be connected. On the positive or line side is a switch carrying a fuse which is held in position by a heat coil; in case of a leakage of ·25 ampere, or the breakdown of the cables to the metal conduit, the solder of the heat coil immediately melts, liberating the switch, and cutting off the current. It is therefore claimed that a permanent earth is provided, so that all danger from shock is prevented. Messrs. Beaumont have also a similar device for switchboards and motor circuits, &c.

Trade Announcements.—The Northampton Accumulator Co. has commenced the manufacture of the "N. A. C." accumulators at West Bridge Works, Northampton. Mr. A. Schanschieff, whose name is well known to our readers in connection with storage battery work, is the company's chief engineer. An illustrated catalogue has just been issued from the press describing the battery for lighting and central station use, also for motor cars and electric traction service. The battery is claimed to be the outcome of 20 years' experience, and the plates are said to possess all the advantages of pasted plates, though they are as solid as those of the Planté type. It is claimed that on account of the homogeneous structure and continuity of the paste, and of its high porosity and consequent large capacity, fewer plates are required for a given output. The double interlocking grid, which locks the active material in, is said to be so secure that the paste cannot be knocked out without completely destroying the grid. The active material is solid, and in one continuous piece inside the plate. Drawings of the grid are given, and some specimen discharge curves. Full working instructions appear in the list, and particulars as to capacities, weights, and prices, are tabulated.

The Planiawerke Aktiengesellschaft für Kohlenfabrikation, of Ratibor, O.S., have removed their offices to Berlin, N.W. 7, Dorotheenstrasse 45.

Messrs. Vandam, Marsh & Co., Ltd., of London, Birmingham, and Manchester, will in future be known as Messrs. Marsh, Son & Co., Ltd., Mr. A. Vandam, late of this firm, having left and gone to South Africa. The above firm, under its new name, will be issuing a very much extended catalogue, embracing many fresh lines and novelties, which will be ready early in July.

Mr. H. Lee has removed to large premises at 410, Holloway Road, N., to which address all communications should be sent.

The Unbreakable Pulley & Mill Gearing Co., Ltd., have just appointed Mr. F. J. Hill (trading as Death & Ellwood), Joseph Street, Leicester, as their agent for the sale of "Unbreakable" pulleys and general mill-gearing in the town and county of Leicester. Mr. Hill has showrooms, and will hold a large stock there.

Portsmouth Dockyard.—The tender for the erection of a generating station for the electric light in Portsmouth Dockyard has been let to Messrs. Kirk & Randall, of Woolwich. The contract for mains has not yet been given out.

Dissolutions and Liquidations.—A petition to wind up Shippey Bros., Ltd., has been presented by Canadian Motors, Ltd., creditors, and is to be heard in the Courts on June 21st.

Messrs. W. G. Pearson and W. H. Lake (Pearson & Lake, accumulator manufacturers, of Dirleton Road, West Ham) have dissolved partnership. Mr. Pearson, who will attend to debts, will continue the business under his own name.

Messrs. G. Newby, jun., and T. Wray (Newby & Wray, electrical engineers, Imperial Chambers, James Street, Harrogate) have dissolved partnership. Mr. Newby will attend to debts, and will carry on the business in his own name at the above address. Mr. Wray has taken offices and showroom at Petergate, James Street, where special attention will be devoted to lamp and installation testing.

Messrs. A. W. Marshall and Mr. W. Woods (Marshall & Woods, electric light engineers and manufacturers, Gray's Inn Road, W.C., and elsewhere) have dissolved partnership. Mr. Woods will continue the business under the old style, and will attend to debts.

Messrs. A. G. Enock, C. W. V. Biggs, and H. C. H. Shenton (Enock, Biggs & Shenton, consulting civil and electrical engineers, of Westminster) have dissolved partnership.

Motor-Wagon for Tramways.—The Huddersfield Corporation has just acquired a motor-tower wagon for use in connection with the maintenance of the tramway ove head conductors. The vehicle was built by Messrs. Thornycroft, of Chiswick, and is fitted with one of their 20-H.P. petrol motors.

Roumania.—A company has just been formed in Brussels with the title La Société de Braila Tramways et Eclairage Electriques, and with a capital of £100,000, to acquire from the Helios Electrical Co., of Ehrenfeld, Cologne, concessions for the electric lighting of Braila, and for the working of a system of electric tramways in that city.

French Rolling Stock for England.—It is reported from Paris that the Metropolian Railway Co., London, has just placed contracts in France for 280 electrical cars. The order has been divided between Les Ateliers du Nord de la France, of Blanc Misseron, Les Ateliers de Construction d'Ivey, La Compagnie de Construction de St. Denis, Messrs. De Dietrich & Co., of Luneville, and Messrs. Dasouches, David & Co., of Pantin.

The "Olaf" Fuse Carrier.—We regret to find that the description which we gave of the "Olaf" fuse carrier was rendered somewhat hazy by an error which occurred at the printers after the page had finally left editorial hands. The description should have read thus:—"The novelty of the board is in the fuse carrier (prov. prot.), which is constructed with solid metal tongues and heavy clamping nuts. It is provided with alternative channels (in and out of sight) for the fuse and for 500-volt circuits; the arrangement permits of 5½ in. length of fuse wire being inserted." The lavatory bolt switch described in our last issue is the invention of Mr. J. Lightfoot, a Manchester contractor. Messrs. Ward & Goldstone, who make the "Olaf" fuse carrier, have issued a new catalogue of their various special lines in electrical accessories, &c.

Refuse Destructors.—Messrs. Meldrum Bros., Ltd., Timperley, near Manchester, have just secured the order for a refuse destructor to be erected at the Sewage Works, Twickenham, the power to be used for sewage pumping.

The Zoelly Steam Turbine.—A large syndicate has been started by some of the foremost German firms, (among them Friedrich Krupp, Essen, the North German Lloyd, and the Vereinigte Maschinenfabrik Augsburg u. Maschinenbaugesellschaft

Nürnberg) for the exploitation of an improved type of the Zoelly steam turbine, just brought out by the Swiss firm of Escher, Wyss and Co., Zürich. The turbine is a multiple stage parallel flow turbine in which the steam is conveyed to the running wheels through guiding wheels, so as to have in the high-pressure stage a partial, and in the low-pressure step a full charge of steam. There is one running wheel between each two guiding wheels, the latter being fitted steam-tight into the turbine casing; the running wheels are mounted on a common shaft, traversing the whole length of the turbine. On the rims of the discs are mounted the turbine buckets, which have the form of relatively long rays, their cross-sections increasing at a regular ratio from outside inwards towards the axle of the wheels, so as to maintain constant the specific strain throughout the length of the bucket, and to secure great strength with respect to both centrifugal force and steam pressure. Comparatively high wheel diameters, and accordingly great peripheral speeds, may thus be adopted, allowing of a much smaller number of stages being used than with steam turbines of other systems. The regulation of the turbine is secured very efficiently by means of an extremely sensitive spring governor, including a servomotor, the admission pressure of the steam being altered according to the load. A further feature is the fact that the turbine shaft is carried by a base-plate quite independently of the turbine casings, so as to avoid any action of the steam heat, or of the thermal expansion of the turbine casings on the bearings; the latter, moreover, are so arranged as to be readily accessible. The safety of working is ensured largely by the absence of compensating pistons, the great clearances between the moving and stationary parts of the turbine, the simplicity and solidity of the running wheels, the small number of the latter, &c. A turbine direct-coupled to a polyphase-current generator built by the Siemens-Schückert Werke, is being operated in the workshops of the company, giving an output of 600 H.P.

Imports of Foreign Electrical Machinery.—The value of the imports of foreign electrical machinery into this country during last month is returned at £35,887, as compared with £39,588 in the preceding month, and £37,466 in May last year. So far as the year has gone there has been a decrease in these imports from £260,505 in the first five months of 1903 to £214,811 in the five months ending with May last.

Catalogues and Lists.—The Sunbeam Lamp Co., of Gateshead, have sent us a circular relating to the oil switches of Messrs. A. Reyrolle & Co., Ltd., for whom they are sole selling agents. The list describes a 50-ampere 600-volt switch suitable for multiphase and direct current power circuits; it is a new design of triple-pole switch, and special attention has been given to ensure reliability under severe operating conditions. Special precautions have been taken to obviate an arc and to simplify the connections; the switch has only one moving part, and is quick-break, a double-break being provided on each pole; the six contacts are mounted on a stout asbestron cylinder. The moving contacts consist simply of three solid copper blocks, embedded firmly in a triangular asbestron carrier, revolving with the operating spindle. The framework consists of one casting, designed to shield the switch and to enclose the porcelain terminal blocks. It is claimed that the break occurs simultaneously on all three poles. In opening the switch a solid body of oil is put in motion and forced past the contacts, thus promptly extinguishing any arc. The oil receptacle can be removed at any time without loosening any of the connections or interfering with the mechanism of the switch; the terminals have been specially designed to facilitate wiring, the framework of the switch is designed for an earth connection, and the switch itself is perfectly waterproof, and can be used out-of-doors, on cranes, &c., on board ship, or in mines. A copy of this illustrated circular (No. 13/4·4) can be obtained on application to the Sunbeam Co.

Mr. F. T. Down, of 6—8, Crutched Friars, E.C., has issued a new list relating to tramcar replacing frogs.

"An All-British Line" is the title of a little pamphlet received from the Brush Electrical Engineering Co., Ltd., and it contains illustrations of their steam and electric locomotives, electric railway carriages, electric tramcars, open and closed, single and double-deckers, electric watering and cleaning cars.

The Berliner Telephone Manufacturing Co. have in circulation among the trade this week an attractive little booklet (No. 65). The company's numerous telephonic apparatus is detailed in some 32 pp., particulars of recent reductions in prices being given.

The Sturtevant Engineering Co., Ltd., of Queen Victoria Street, E.C., has issued a sheet of illustrations showing its standard types of British-made motor and dynamo controllers for electric lifts and cranes, theatre heating, switchboards, and other purposes.

A very neatly-arranged catalogue of convenient size has been brought out by the Blake & Knowles Steam Pump Works, of 179, Queen Victoria Street, E.C., giving details and views of their cooling towers, condensers, feed-water heaters, air pumps, &c. An accompanying leaflet describes the Blake & Knowles oil separators.

A catalogue of Evershed's electric gauges has been received from Messrs. Evershed & Vignoles, Ltd., of Chiswick. Illustrations of their volt and ampere gauges, including the sector, dead-beat, and portable patterns are given, prices being tabulated, and scale diagrams shown. Some drawings are included, showing the positions and dimensions of holes that have to be drilled in switchboards to receive the instruments. A smaller list has been issued by the same firm containing a summary of the contents of the full catalogues of electric gauges, and ammeters, and voltmeters of the soft iron and moving coil types. Some modifications have been made in the prices of certain instruments.

The General Electric Co., Ltd., have placed before us a copy of the new edition (ninth) of their telephone list, which includes a collection of G.P.O. standard apparatus of high quality, and much other apparatus of British manufacture. The G.E.C. electric traction telephone system, which is in use on most of the electric tramways in this country, including the L.C.C. lines, and a list is given of the towns which have adopted it. The "S.B." wall type and other intercommunication sets are set forward. The selection is made by means of "push buttons," which replace themselves automatically when conversation is finished. Among the G.P.O. standard apparatus, an illustration is given of a secondary cell charging switchboard, which allows of cells being changed from day to day, and connected into the charging circuit without in any way interfering with the working of the line. This arrangement is claimed to overcome the difficulty involved in maintaining the cells at a constant voltage, for by the movement of the lever which controls the "barrel" switch, different sets of cells are brought into use periodically, without stopping the line current for a single moment. Other features in the list are fire brigade alarms and telephones for naval and military use.

The Edison & Swan United Electric Light Co., Ltd., have sent us two further catalogue sections of their 1904 series. These comprise section VII. (glass and silk shades) and section X. (telephones). The first contains a large quantity of illustrations of glass shades, which show up very well on a black background; these include many styles, from the ordinary conical to the most elaborate cut-glass, and some of the designs are of an entirely novel kind. The telephone catalogue comprises a large number of the best selling lines, from domestic to municipal telephones, and a special feature is made of inter-communication sets. There are also some neat wall instruments shown.

The question as to whether a mine will prove a dividend-paying property depends, in many instances, upon whether electricity is adopted or not. Messrs. Johnson & Phillips, of Old Charlton, who have made a speciality of this branch of industry, have published an illustrated brôchure entitled "Electric Power," and from the evidence given by the authorities at the various mines for which they have installed electric plant, there can be no doubt that electricity may often enable a mine to turn the financial corner. Some of their plant, although working under the worst possible conditions, is stated to have been practically free from interruptions. The mines equipped by the firm include the Sheba, Burma, Ruby, Rauo, and Rezende, and the plant installed in these is described briefly, and well illustrated, in the publication before us. This book should be of service to those who are interested in the success of mining undertakings, for it deals at some length with the economies to be effected by the adoption of electric transmission and distribution of power. Any of our readers who take a special interest in this branch of electrical work can obtain a copy of the brôchure on application at the Victoria Works, Old Charlton.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—The Electricity Committee of the T.C. has undertaken to supply energy, globes, &c., for arc lamps in the markets at the following rates: — 65 existing lamps, £14 per annum each; 15 enclosed arc lamps to 11 p.m., £9 each; 18 enclosed arc lamps, all night, £16 each.

Barnsley.—The T.C. has applied to the L.G.B. for a loan of £800 to meet the cost of standards and arc lamps for street lighting.

Barrow.—The E.L. Committee recommends that application be made for further borrowing powers to the extent of £35,000 for extensions.

Caerphilly.—The B. of T. has issued a prov. order to the U.D.C. to supply electricity within its area.

Cannock.—The U.D.C. has decided to appoint Mr. F. Brown, of Walsall, as consulting electrical engineer.

Carnarvon.—The L.G.B. has sanctioned a loan of £17,000 for supplying the town with a scheme of electric lighting and power.

Coventry.—It is interesting to note that for the first time in the history of the Coventry Corporation electric light undertaking, a substantial surplus has accrued as the result of the past year's trading. The accounts, which have just been issued, show that after paying interest and sinking fund, there is a balance to the good of £775. This satisfactory result is mainly due to a close following up of the progressive policy introduced some time ago, and also to the economies which the manager, Mr. J. E. Jeckell, has been able to effect in the cost of production. The number of consumers has been steadily increasing, both for lighting and power purposes.

Dawlish.—The U.D.C. has decided to grant the transfer of the prov. order to Messrs. Crompton & Co. in the form approved by the B. of T.

Dublin.—Owing to the impossibility of raising a loan of £50,700 for the completion of the E.L. undertaking at a lower rate of interest than 4 per cent., the Corporation has been compelled to adopt a suggestion of the City Treasurer to borrow the necessary funds from a bank for a period of two or three years. Probably the Bank of Ireland will supply the money.

Dundee.—Preliminary arrangements have been made for establishing in Dundee a scheme for driving mills, factories, and other large works by electricity. It will involve a capital cost of about £250,000. Mr. G. Balfour, the promoter of the scheme, is reported to have said that about 10,000 H.P. will be used as soon as the station is ready.

East Molesey.—The gas company has lodged a petition against a prov. order for E.L. being granted to Edmundson's Electric Lighting Co., with the object of getting inserted a clause providing that, in the event of the U.D.C. becoming the purchaser of the undertaking, a charge for energy sufficient to render it self-supporting shall be made, so that no charge shall fall upon the rates. The U.D.C. has decided to oppose the petition.

Edmonton.—The recently-elected Moderate majority on the Edmonton District Council has decided to reverse the policy of its predecessors in regard to the question of electric lighting.

The late Council adopted a scheme for establishing an undertaking at an estimated cost of £44,000, and directed that preparations should be made for carrying out the necessary works.

The new Council, however, has resolved that the North Metropolitan Electric Power Supply Co. and the Tottenham and Edmonton Gas Co. be invited to state the terms upon which they would lease the Council's prov. order.

Exeter.—At the City Council meeting last week a proposal was made to erect a showroom in Exeter, in connection with the new electric light station. A protest was entered against the Council engaging in trade operations by the sale of electric fittings, to the detriment of private traders. An assurance was given by the chairman of the Electric Light Committee that the Council had no such idea, though the Committee would sell lamps as hitherto. It was submitted, however, by several councillors that inasmuch as the Exeter Gas Co. had opened in the city a large showroom for the sale and hire of gas stoves and gas fittings, in competition with hardware dealers, it was equally open to Exeter City Council to trade in electrical fittings. The work must be taken up as a pure matter of business, and must be so run as to pay. Obviously this is beside the question altogether, for the hardware dealers do not pay rates to, or owe allegiance to, the gas company. Several councillors objected most strongly to this form of municipal trading, which they regarded as being destructive to private enterprise and altogether uncalled for. They asked where municipal enterprise was to stop—when it was found that private traders were crippled or ruined? The whole subject was referred eventually to the Electric Light Committee, with authority to establish a showroom and inquiry office, but on the express understanding that no business was to be carried on in fittings and appliances.

Faversham.—On Thursday last week the new electricity works of the Corporation were formally opened. Messrs. Talbot and Stevenson were the consulting engineers, and Mr. G. Sommerville is the borough electrical engineer. The plant comprises two Dowson gas producers, two Westinghouse gas-dynamos of 58 KW. each, and a battery of E.P.S. cells. Messrs. Callender's Cable and Construction Co., Ltd., were the contractors for the mains. Ten arc lamps are provided for street lighting, and Nernst lamps are also to be used in all streets where mains are laid.

France.—La Société d'Electricité de Paris is erecting a large central station on the banks of the Seine, at St. Denis. When completed—next year—it will be the largest in Paris. The plant which is being put down includes four 7,000-H.P. steam turbines and generators.

Gillingham.—The members of the Chatham Dockyard Fitters' Apprentices' Association recently visited the Gillingham Corporation electric power station at New Brompton. Mr. Chalmers, borough electrical engineer, and his assistant, Mr. Ryan, conducted the party over the works, and explained the plant.

Glasgow.—The Electricity Committee has acquired ground in French Street, Dalmarnock, from the Gas Committee, whereon to construct meantime a sub-station and ultimately a generating station in connection with the supply of electricity to the eastern district of the city.

The Sub-Committee on Electricity has agreed to accept an offer from—

Wilskemp, Ltd., Wandsworth, London, to provide and fit up an installation of their patent smoke consumer and fuel economiser on four of the boilers at the Pollokshaws Road generating station, upon the following terms and conditions, viz.:—(1) That the apparatus is to be fitted up for approval for a period of three months; (2) That, if the apparatus does not prove efficient, to the entire satisfaction of the electricity department, the same will be taken out of the station, and everything made good by the offerers, as found by them before the apparatus was put in, and that free of charge to the Corporation; and (3) That if, at the end of the period of three months, the apparatus is found to be satisfactory, as aforesaid, the price to be paid therefor by the Corporation is £280.

Hessle.—The U.D.C. has resolved to apply to the B. of T. for a prov. order for electric lighting within the urban district and the adjoining parish of Anlaby.

Hetton-le-Hole.—The U.D.C. has resolved to oppose the application of a private company for a prov. order for electric lighting.

Hove.—The T.C. has decided to enter into a contract with Brighton T.C. for the supply of electricity in Aldrington for private lighting.

Italy.—Application has been made for a concession to put down plant to utilise the water-power of the Rivers Pestia, Sermigliasia and Vopaio, in the Trebbia Valley, in the generation of electrical energy for lighting and power purposes at Genoa.

Northfleet.—The Gravesend Council is about to take steps to endeavour to obtain a prov. order for Rosherville. Some time ago the Northfleet U.D.C. made verbal arrangements with the Kent Power Co. to do this, but nothing definite was settled; however, the U.D.C. has resolved to oppose the application of Gravesend T.C. for powers.

Market Harborough.—The U.D.C. has decided to circularise the town on the E.L. question with a view to ascertaining the number of consumers likely to be obtained. The proposed prices are 6d. per unit for the first hour and 4d. afterwards, for lighting, and 3d. per unit for power.

Lynn.—The balance-sheet for the electricity works for the year ending March 31st, 1904, shows an income of £5,686, and an expenditure of £5,199, including capital charges, leaving a net profit on the year's working of £486, compared with a deficiency of £47 on the previous year's working. The profit is to be applied towards payment of the overdraft due to past losses.

Kearsley.—The U.D.C. is negotiating with the Farnworth U.D.C. with reference to the transfer of the E.L. order.

King's Norton.—The B. of T. has agreed to defer consideration of the question of revoking the prov. order, for three months.

Leek.—Last week the electricity undertaking was formally inaugurated by the U.D.C., and an electrical exhibition was held at the works. Mr. R. M. Carr is the electrical engineer to the Council. The station was designed by Messrs. Burstall and Monkhouse, and the generating plant comprises two Stockport gas engines coupled to 60-KW. dynamos, made by the Industrial Engineering Co., of Newton, Hyde, together with a balancer and booster, and a battery supplied by the A.B.P. Accumulator Co. The mains were made and laid by Callender's Cable and Construction Co., Ltd. The total cost was £7,433.

London.—ST. PANCRAS.—The B.C. has resolved that a further expenditure of £1,276 be sanctioned to enable the overhanging method of arc lamp suspension to be adopted throughout the present extensions.

HACKNEY.—The B.C. has agreed to adopt a new tariff of charges for electrical energy, ranging from 7d. per unit for lighting, and 3d. per unit for power for one hour's use per day, to 1·25d. per unit for lighting and 1·08d. per unit for power for 24 hours per day, consumers on the books previous to the date when the new scale comes into force, and places of worship (whenever connected) to have the option of retaining the existing scale of charges.

FULHAM.—After considerable correspondence a settlement has been come to between the B.C. and the British Insulated and Helsby Cables, Ltd., in regard to alleged breach of contract by the latter by delay in completing mains extensions. The Council's claim is to be arranged by the payment of £750 by the company. The town clerk is, on behalf of the borough, to oppose the Electricity Supply Bill, 1904.

METROPOLITAN ASYLUMS.—The Board, on Saturday, accepted the following offers to supply energy:—From Hackney Borough Council, for Eastern Hospital, 4d. per unit for lighting (subject to a discount of 10 per cent. on the account being paid within 21 days), 2d. per unit for power, net; from Fulham Borough Council, for Western Hospital, 5d. per unit for an average consumption of 12 units per 8-C.P. lamp per annum; 4d. per unit for an average consumption of from 12 to 24 units, 2d. per unit for all units over an average of 24 per 8-C.P. lamp per annum. It was resolved to install internal telephones at both these hospitals, at an estimated cost of £280 for the Eastern and £300 for the Western Hospital.

Luton.—In order to supply the Vauxhall Ironworks Co. with electrical energy, the T.C. has resolved to lay a cable to the premises referred to at a cost of about £870.

Motherwell.—The burgh electrical engineer's annual report shows that during the past year the total expenditure was £3,033, and the total income £6,735. There was a net profit of £164 on the year's working. Mr. Samuel Williams, who has been mains superintendent, has been appointed electrical engineer.

Rochdale.—The Council has resolved to apply to the L.G.B. for sanction to borrow £42,405 for the extension of the electricity works.

Rutherglen.—The T.C. has agreed to make application for a prov. order to supply electricity in the burgh for all purposes, and authorising the Corporation to transfer the order to the Glasgow T.C.

Standish.—The U.D.C. has requested the manager of the Lancashire Electric Power Co. (Mr. Herring) to obtain, as far as possible, particulars of what supply of electricity is required in the district, and give the Council information as to the probable cost per unit.

Stockton-on-Tees.—The T.C. has decided to supply electricity to firms whose electric lighting units do not exceed 20 per cent. of the total amount taken for power purposes, at a flat rate of 2½d. per unit; all lighting units taken above this amount to be charged at 6d. per unit.

Walsall.—The E.L. Committee has decided to extend the electric mains, at a cost of £447.

(*Continued on page* 999.)

RECENT PROGRESS ON THE L.C.C. TRAMWAYS.

The switchgear supplied by the British Westinghouse Electric and Manufacturing Co. to the London County Council, under the specifications issued by Messrs. Kennedy & Jenkin, for the Deptford generating station, and for the sub-stations at New Cross, Camberwell and the Elephant and Castle, and erected under the supervision of their resident engineer, Mr. Riviere, presents numerous features of interest. Especially is this the case with the high-pressure boards, both at the generating and the sub-stations. The sub-station gear is identical in all three cases, with the exception of the number of panels; an account of the apparatus installed at New Cross will therefore suffice for them all.

There are three separate boards installed: one for the control of the 6,600-volt three-phase 25-cycle incoming feeders, and the synchronous motors of the motor-generator sets; a second board to control the direct current 500-volt generators driven by the above motors, and an exciter board of special construction. The high-pressure board and the direct current generator board are placed in line a short distance apart, and are supported at a distance of about 3 ft. from the wall by iron stays. The exciter board is placed immediately opposite the high-pressure board, so that reference can easily be made to it when manipulating the synchronous motors; this board is, moreover, of such a height that the attendant can look over it at the machines. Its appearance is clearly shown in fig. 3.

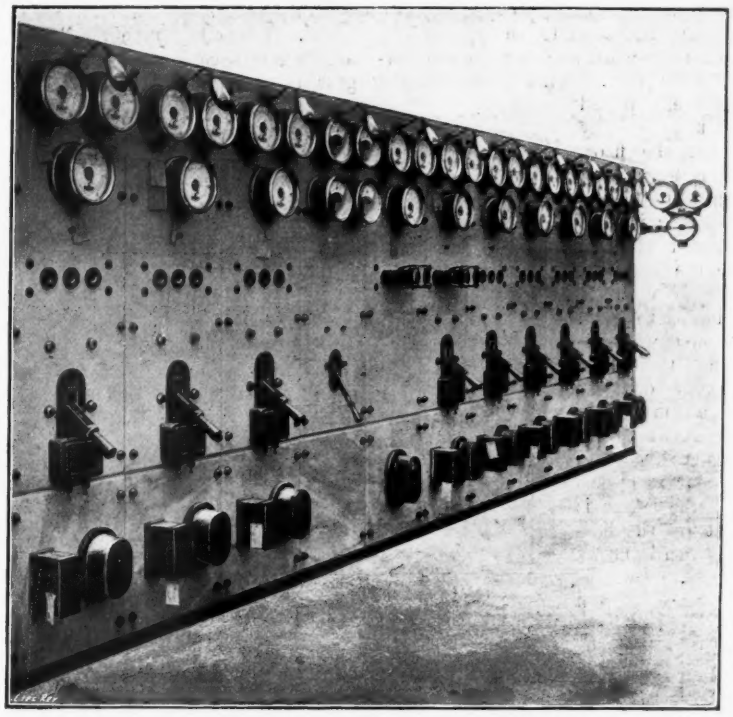


Fig. 1.—High Pressure Switchboard for New Cross Sub-station.

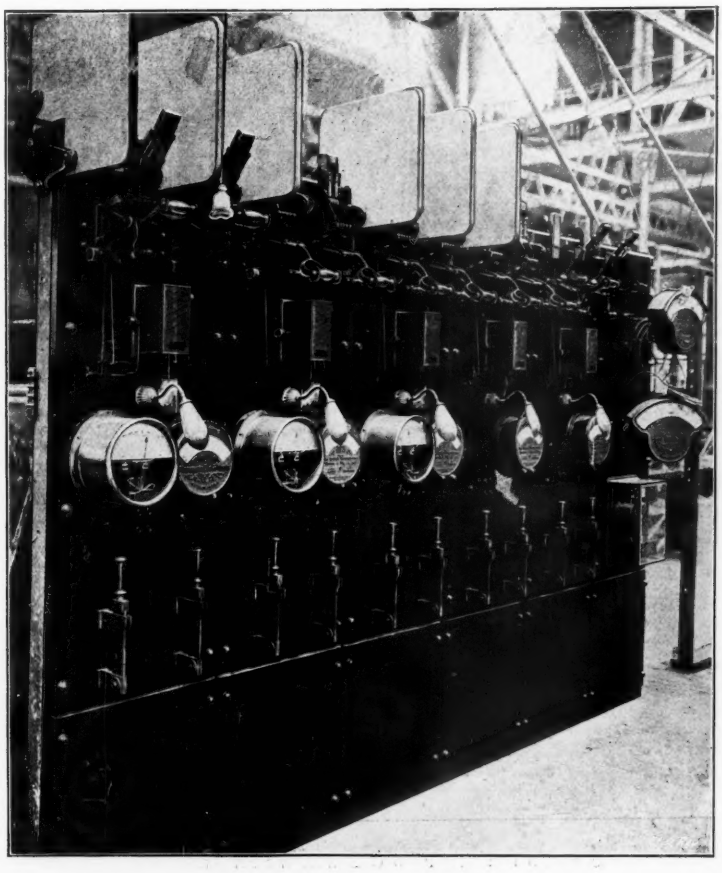


Fig. 2.—Direct Current Generator Switchboard for New Cross Sub-station.

The high-pressure board, fig. 1, consists of 11 white Sicilian marble panels, 2 ft. wide and 2 in. thick, bolted to angle irons. The three-pole oil switches, of the Westinghouse type "B" pattern, as described in more detail hereafter, and the high-pressure synchronising plugs and their connections, are mounted direct on these panels, but the instruments are all of the low-pressure type, run from shunt and series transformers. The cases of the instruments, and the frames of switches, &c., are all carefully earthed, as a precautionary measure. All the interconnecting cables and bus-bars are heavily insulated and mounted on porcelain insulators. The high-pressure bus-bars are enclosed in fireproof cubicles in a subway underneath the switchboard floor. This arrangement tends to economy in space.

Taking the panels in left to right progression, looking at the front, the first two control each a 500-kw. high-pressure incoming feeder, and the third a similar feeder of 1,000 kw. On each of these panels are mounted three long scale alternating-current ammeters, one for each phase of the current. An overload and reverse-current relay working with a time-limit relay serve to trip the Westinghouse oil circuit breaker on each panel when required. A three-pole high-pressure synchronising plug completes the equipment of each feeder panel.

The fourth panel carries four static earth indicators, and one special small three-pole oil switch. Each static indicator is connected to a condenser, one pole of which is joined to the bus-bars, so that the instruments themselves are at a low potential. Their purpose is to show if an earth exists on the

high pressure lines, and if so to what extent it has developed. Two of the indicators are connected to the main bus-bars, and the other two to the synchronising bars. The oil switch is provided to connect the feeder-charging resistance to the bus-bars. This feeder-charging gear is a water resistance, placed in the subway beneath the floor, and is such that when a high-pressure feeder is first connected through it to the bus-bars, less than one ampere is allowed to pass. The water resistance is then gradually cut out by a movable plunger, which reduces the column of water in circuit until the feeder is direct on the bus-bars and fully charged. By this means the insulation is relieved of the stresses caused by the high voltages set up in a cable of such a capacity when current is suddenly switched on to it.

Fig. 3.—Exciter Switchboard, New Cross Sub-station.

On the fifth panel are mounted three long scale ammeters for reading the feeder-charging current, a three-pole synchronising plug for inter-connecting the feeder and motor synchronising bars, and a polyphase watt-hour-meter, for recording the total energy taken by the station.

The sixth panel controls a 60-KW. induction motor, and the seventh, eighth, ninth, tenth, and eleventh panels each control a 300-KW. synchronous motor. These six panels bear practically identical gear, consisting in each case of one long-scale ammeter, one time limit overload and reverse current relay, connected with the trip gear of a Westinghouse type "B" automatic oil switch, and a three-pole high pressure synchronising plug.

In addition to the above there are mounted on swinging brackets at either end of the board two long-scale voltmeters and a synchronoscope.

The 500-volt direct-current generator board (fig. 2) is, as already mentioned, fixed in line with the high pressure board, and comprises six black enamelled slate panels, 2 ft. wide and 2 in. thick, bolted to angle irons. Five of these panels control each a 300-KW. direct current generator, driven by the synchronous motors above referred to. Each panel bears a direct current ammeter with shunt, a Kelvin & White indicating wattmeter, two knife switches, two Westinghouse type "C" automatic carbon-break circuit-breakers, with time-limit overload and reverse current release, and one voltmeter plug socket. The sixth panel registers the total output, and contains an integrating wattmeter and two Westinghouse type "E" illuminated dial voltmeters on swinging brackets.

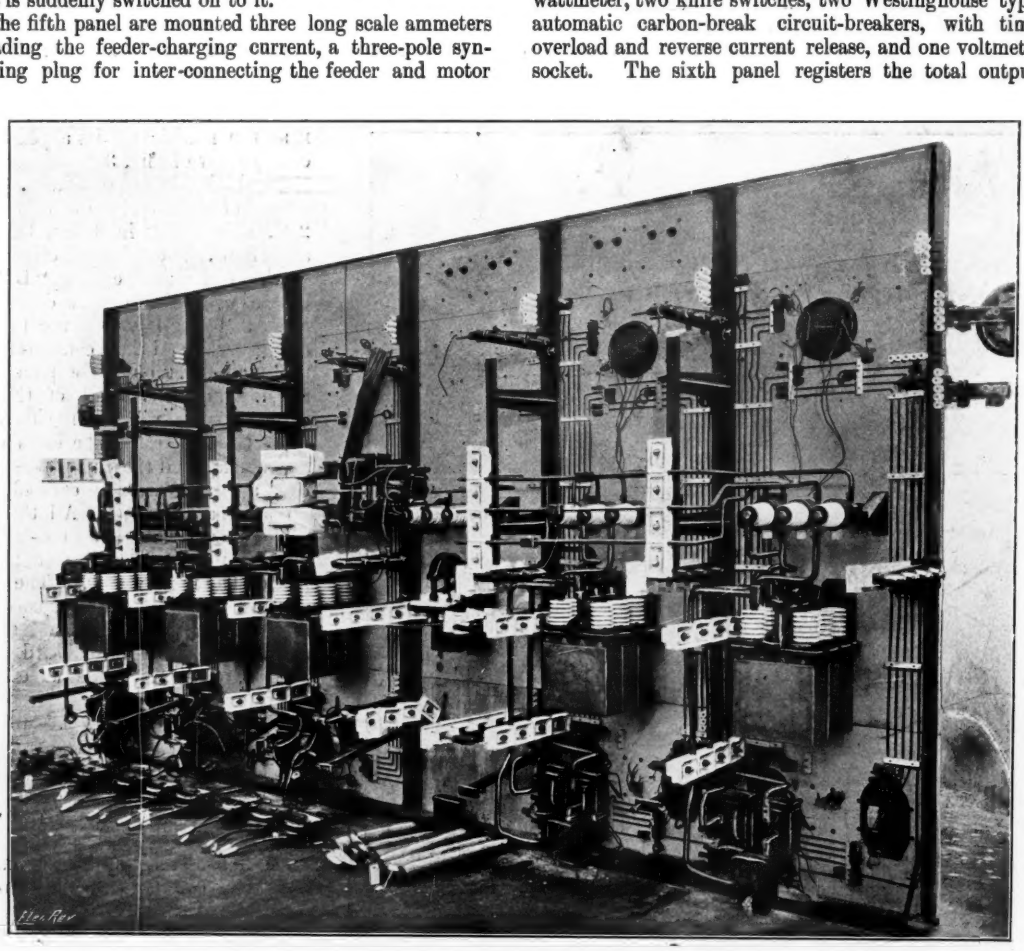


Fig. 4.—Back of High Pressure Switchboard for Deptford Generating Station.

The 125-volt exciter board, fig. 3, consists of seven black enamelled slate panels, 2 ft. wide and 2 in. thick; by special construction, the height has been kept down to about 4 ft., and the operator can thus easily see over it. The first

five panels control the exciters for the synchronous motors, and each has mounted on it two direct current ammeters with shunts, one double-pole double-throw knife switch, with special discharge resistance, one double-pole single-throw knife switch, and one voltmeter plug socket. The sixth panel controls a 60-KW. direct current machine driven by an induction motor controlled from the A.C. board. This generator supplies the station lighting and the power required for running the synchronous motors up to speed, while it further serves as a stand-by for the exciters. The panel carries one ammeter with shunt, one integrating wattmeter, two reverse current circuit-breakers, two knife switches, and one voltmeter plug socket. The seventh panel controls the station lighting, and bears one ammeter and shunt, and two overload current circuit-breakers. Two illuminated-dial voltmeters are mounted on a swing bracket on an upright stanchion adjacent to the switchboard.

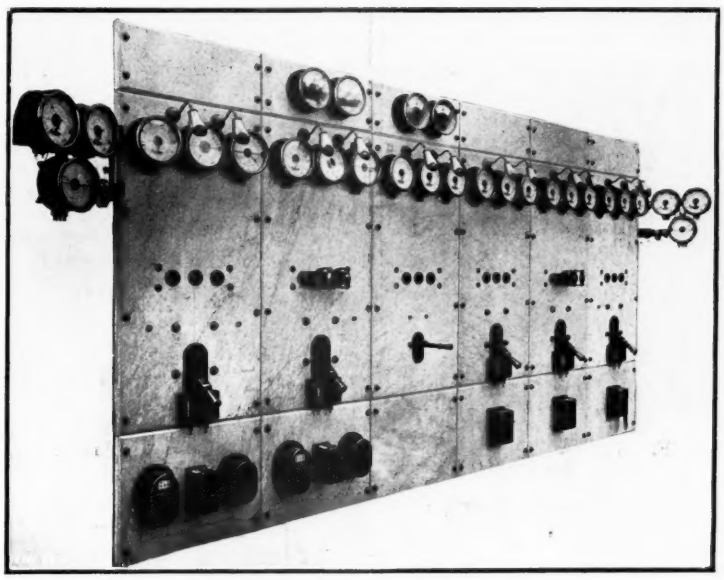


FIG. 5.—HIGH PRESSURE SWITCHBOARD FOR DEPTFORD ELECTRICITY WORKS.

The main differences in the arrangement of the high-pressure gear in the sub-stations and in the generating station are due to the fact that in the latter case much more space was at the disposal of the designers. The British Westinghouse Co. have supplied for the Deptford generating station a high pressure generator and feeder board, and a low pressure exciter board. The disposition of the main bus-bars differs from the practice followed in the sub-stations, the enclosing fireproof cubicles being in this case located directly behind the switchboard (fig. 4). The cubicles, are, moreover, so designed that at a future date when the need arises, a second set of bus-bars may be installed, the selector plugs for which would be mounted on marble slabs on an upper gallery above the existing board.

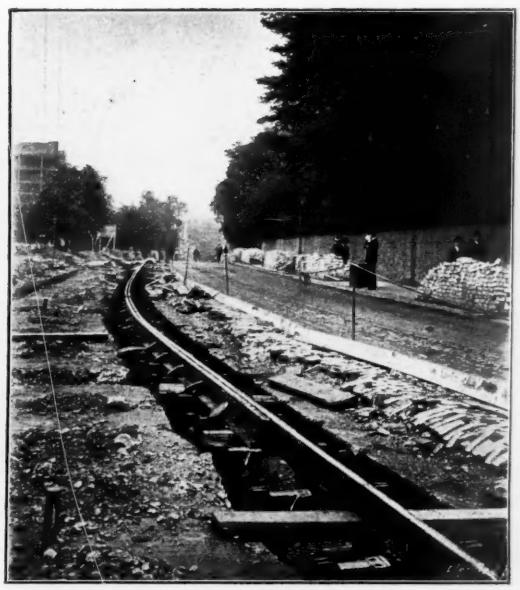
The high pressure board, fig. 5, consists of six panels of white Sicilian marble, 2 ft. 8 in. wide and 2 in. thick, bolted to angle irons. Oil switches and synchronising plugs similar to those in the sub-stations are employed. The first two panels, counting from left to right, are for the control of two 1,500-KW. three-phase generators, running at 6,600 volts and 25 cycles per second, and are each supplied with the required instruments, viz., one long scale ammeter, one indicating wattmeter, one power factor meter, one integrating wattmeter, one time-limit overload and reverse current relay, one three-pole automatic oil switch, and one three-pole synchronising plug. The second panel has also two static indicators for showing the state of insulation of the bus-bar connections, feeders, &c.

The third panel is for the control of the feeder charging apparatus and the load. It is fitted with three long scale ammeters, one special oil switch, one three-pole synchronising plug, two static indicators for the synchronising bars, and one integrating wattmeter.

The fourth, fifth and sixth panels each control a 1,000-KW. feeder, and carry each three long scale ammeters, one over-load time-limit relay, one three-pole automatic oil switch, and one three-pole synchronising plug.

The exciter board is of similar construction to those in the sub-stations, and is arranged face to face with the A.C. board on the switchboard gallery. It consists of three panels, of white Sicilian marble, the first serving for the control of a 157½-KW. 125-volt, direct-current auxiliary steam-driven generator, while the second and third are for the main gene-

FIG. 6.



KENNINGTON—STREATHAM TRAMWAY. FIG. 7.

rator exciters. These panels are fitted with the requisite controlling, indicating, and recording apparatus for their respective duties. Two illuminated dial voltmeters are also supplied, mounted on a separate pedestal adjacent to the board. The water resistance for the feeder charging gear is placed in the gallery below the switchboards, and is of similar character to those already described.

The Westinghouse type "B" oil switch, which is used for breaking all high pressure circuits, merits special description. The principal features of the design, include the submersion of all live parts in oil; positive and direct action; quick break; inability to be held in closed position when there is a short on the line; open position maintained by gravity; small quantity of oil; and accessibility of contacts. The

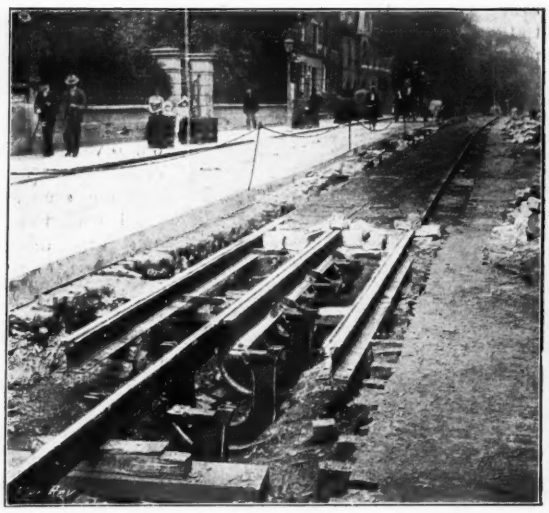


Fig. 8.

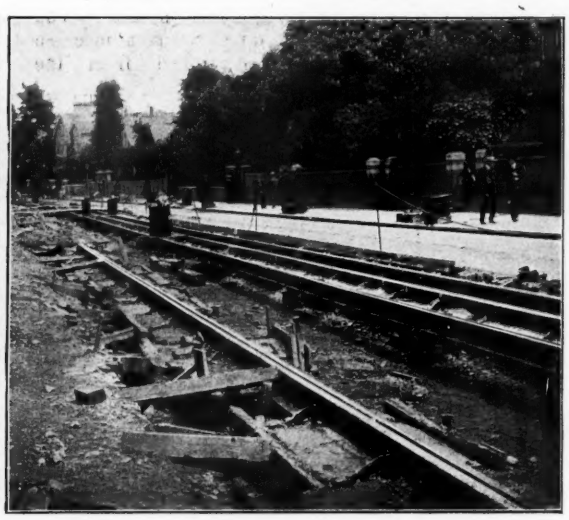


Fig. 9.

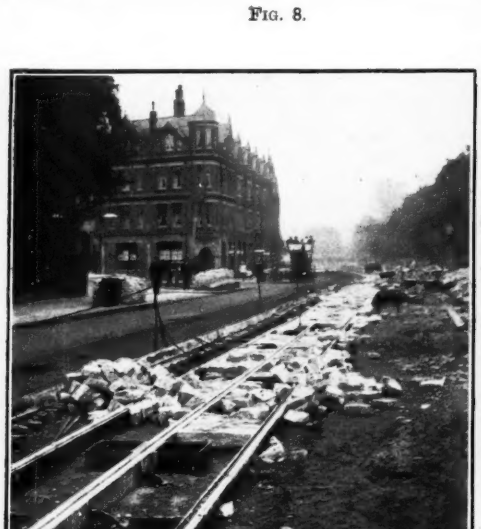


Fig. 10.

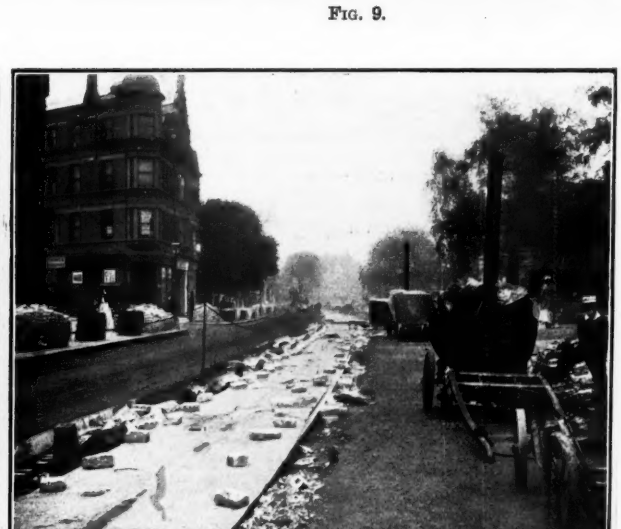


Fig. 11.

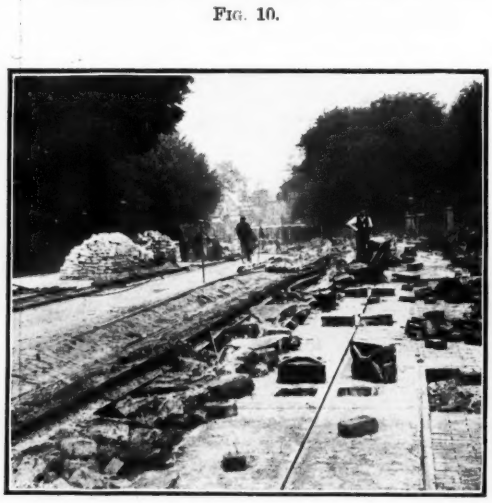


Fig. 12.

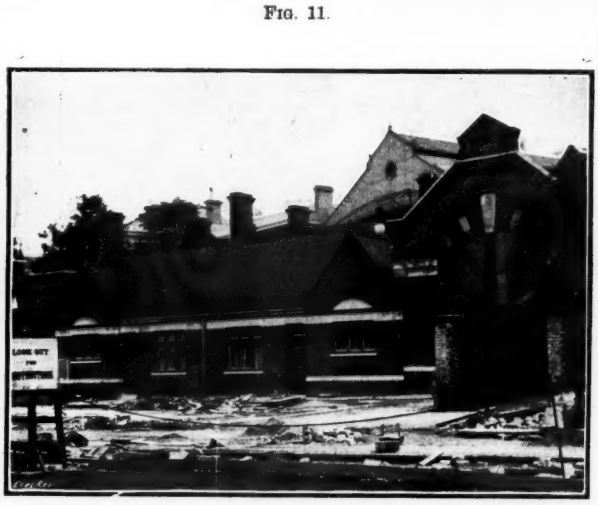


Fig. 13.

breaker is specially designed for switchboard service, the method of mounting obviating any difficulty of adjustment of triggers due to varying thickness of the panels. The operating handle, releasing trigger, and automatic tripping mechanism are on the front of the panel, and the contact mechanism, oil tanks, and supporting frame on the rear.

There is a tank full of oil to each pole of the breaker, and in this the live metal parts are immersed. The tanks are independent of each other, and have a lining so formed as to reduce the quantity of oil required, and serve as a barrier between the two stationary contacts, while allowing ample space for the operation of the moving contacts. This lining serves as an insulation, and reduces to a minimum all danger of the arc communicating through the oil.

The circuit breaker is automatically operated through a range of from 70 per cent. to 150 per cent. of normal full load current; the tripping coils may be set to any point within this range by means of the adjusting screws at the bottom of the coils. These tripping coils are energised from the secondaries of series transformers in the main circuit, or from an outside D.C. source, thus avoiding high voltage on the face of the panels.

A very important and desirable feature is that this switch cannot be held closed, in spite of the action of the tripping coils. To accomplish this end, two levers are provided, one within the other; the outer lever bearing the operating handle, and the inner connected to the breaker mechanism. Normally, a trigger on the outer lever engages with the inner, and the two levers move together. This trigger is, however, acted on directly by the tripping coils, and thus if these are energised, due to overload or reverse current as may be, the core of a tripping coil releases the trigger, and allows the inner lever to return to its upper position, opening the circuit. The handle must then be returned to the upper position before the circuit can again be closed. Under ordinary conditions, the operating handle and the inner lever are held down by a trigger secured to the bracket supporting the coils. The breaker may be tripped by hand by pressing the insulated button in the end of the operating handle, or by pushing up the core of a tripping coil.

In the largest sizes these breakers are mounted apart from the switchboard, but the automatic mechanism, consisting of tripping coils and handle, is fitted to the panel as usual, and connected to the breaker by means of rods and levers, the front of the panel presenting the same appearance as when the breaker is mounted directly on the rear.

On Tuesday last the Kennington—Streatham route, which has been converted from cable to electric haulage in a remarkably short period by the contractors, Messrs. J. G. White & Co., Ltd., was re-opened for public traffic. The special work was sublet to the Hadfield Steel Foundry Co., Ltd., while the Anderston Foundry Co., Ltd., supplied the cast-iron yokes, road boxes, and covers. The work to be done, including some small extensions in Tooting, comprised a total length of 8 miles of single track, and was to be completed within three months from March 31st; the contractors have therefore saved more than a fortnight in carrying it out, and a large portion of the route has been in operation since the end of May.

We give herewith a number of views showing the work in progress. The illustrations almost explain themselves, but we may add the following notes for greater clearness:—

Fig. 6 shows the initial stage, the cable conduit having been removed, and the preliminary excavation made for the electric conduit. The positions of the yokes in the trench are shown.

Fig. 7 shows the slot rails fixed to the yokes, and the temporary centring for the concrete conduit being placed in position.

Fig. 8 is a view of the naked steel and ironwork, and of the completed track.

Fig. 9 shows the conduit completed, and the track rails being laid.

In fig. 10 the concrete foundation for the track has been laid and the granite setts are being placed in position.

Fig. 11 shows the half-completed pavement covered with tarpaulins, to keep moisture from penetrating between the setts before the joints are filled with pitch.

Fig. 12 shows the "down" track completed, and the old "up" cable track in course of being ripped up.

Fig. 13 is a view of the old cable power station and car depôt on Streatham Hill, which will now become a converting sub-station for the electric tramways.

LIGHTING AND POWER NOTES.

(*Continued from page* 994.)

Tunstall.—The U.D.C. has decided to consent to the Burslem Corporation obtaining a prov. order to supply electricity to Tunstall, embodying the terms already agreed upon by the two districts.

Wakefield.—A surplus of £1,894 is shown in the working of the electric lighting department for the year ending March 31st, 1904. The income has been £8,419, and the expenditure £3,195, showing a gross profit of £5,224, out of which £3,331 is paid for interest and sinking fund.

Warrington.—The L.G.B. has sanctioned the borrowing of £5,000 for electric lighting extensions.

Wolverhampton.—The E.L. Committee reports that the provision of electrical generating plant at the new refuse destructor in Crown Street, for the purpose of utilising the steam generated by the combustion of the refuse, will necessitate the laying of feeder and distributing mains to deliver the electrical energy into the existing network, and to supply the large manufacturing district in the immediate vicinity of the destructor station. The electrical mains are consequently to be extended at an estimated cost of £2,800. Application is to be made to the L.G.B. for sanction to a loan of £10,000 to provide, first, for the above extensions; and, secondly, for further extensions as and when required.

West Bromwich.—Fourteen of the leading employés of the Corporation Electricity Department recently submitted a very remarkable petition to the Electricity Committee. In this document it is stated that for a considerable time there has been a strong feeling amongst the majority of the staff that the work cannot proceed satisfactorily as long as a certain official continues his annoying visits to the works. The petitioners point out that this interference results in a lack of discipline, for certain of the workmen seem to think that because they have this official's influence at their backs they can do as they like. Further, it is stated, that the foreman fitter receives a higher rate of pay than any one else in the works, excepting the chief engineer—a fact which they attribute to the foreman's anticipated relationship (*i.e.*, son-in-law) with the gentleman in question. The petitioners, therefore, bring the matter before the notice of the Committee in the hope that steps will be taken to curtail this official's interference and power for harm. At the same time the petitioners take the opportunity of expressing their loyalty to and sympathy with Mr. Wray (borough electrical engineer) in the very awkward position in which he is placed in connection with the present trouble.

A special meeting of the Electricity Committee was held on Monday for the purpose of considering the petition, when Alderman Pitt explained that he appeared to be the main cause of the complaints, and it looked as if his attendance at the works so frequently was not in harmony with the employés' feelings. He regretted that the present trouble had arisen, but in order to avoid further friction he would undertake to stop his frequent visits to the electricity works, and would only attend when on official business, and he further intimated that he would duly notify the manager of any official visits he intended to make. The Alderman's statement was accepted by the Committee, who expressed the hope that there would not be any further unpleasantness.

There will now, no doubt, be a hurricane of similar petitions from the harassed municipal staffs all over the country. May they all have an equally happy outcome!

Windsor.—The Windsor Electrical Installation Co., Ltd., has notified the R.D.C. that it intends to apply to the B. of T. for a prov. order for supplying electricity to the parishes of Clewer Without and Old Windsor. The Council has decided to ascertain the company's terms for public lighting, and the feeling of the parishes in the matter.

Yarmouth.—The receipts of the electric light undertaking last year amounted to £13,486, and after defraying all costs of production, there was a gross profit of £5,870. From this sum £4,577 has been paid as interest, in rebates, and for capital repayments, leaving a profit of £1,293.

York.—The statement of electric lighting accounts for the year ending March 31st last shows that the total income for the year was £9,112 11s. 2d., and the working expenditure was £4,962 15s. 4d., leaving a balance to be transferred to net revenue account of £4,149 15s. 10d. Of this balance, £3,799 4s. 3d. is required to meet interest and sinking fund, leaving a surplus of £350 11s. 7d., which has been transferred to reserve fund account, and used for wiping out the deficit of £351 6s. at March 31st, 1903.

TRAMWAY AND RAILWAY NOTES.

Aston Manor.—A preliminary run was made on the newly electrified tram system here last week.

Beckenham.—In October, 1902, the U.D.C. signed an agreement with the B.E.T. Co. to lease a proposed tramway to run into Beckenham for 1¾ miles, this being a continuation of the line to be constructed from the terminus of the present electric tramway from South Norwood, through Penge, to the Beckenham boundary. The Bill was promoted by the Beckenham Council—which undertakes to construct the line—which Bill was carried through Parliament last year. The lease was granted for 28 years, and the capital outlay for this electric trolley line is estimated at £28,000, and the B.E.T. Co. agree to not only repay this, but to give the Beckenham Council the benefit of increasing percentages, which it is claimed by the Council itself will work out at a total profit in the 28 years of £13,789. In addition to the rent which the Council receives on the cost of construction, an annual sum has been agreed upon equivalent to the sinking fund and interest which would be required to pay the capital cost, limited to £3,300, for widenings, and for this the Council has given the estimate of a total payment of £17,627 from the company. The Council also stated that the amount required for this outlay will be about £27,700, the net cost of the widenings. The company have also agreed to give the Beckenham Council an option to supply energy at 2d. per unit, with the minimum payment of £900 per annum when the agreement was signed; the station supplied 50,000 units per annum, but under the guarantee of the company they would be entitled to 108,000 units. The engineer estimates that only one other engine of 150 KW., at a cost of £5,000, will be required to supply this energy, and after repayment of loan instalments the Council estimate a balance of at least £575 per annum. At the end of 28 years the tramway is to be handed over to the Council free of all cost "in good working order and repair," and the Council estimate that the undertaking will then be worth £18,000. There are other terms in the agreement which, according to the figures supplied officially to the ratepayers brings up the total payment by the company in 28 years to £55,800, and this is apart from any profit to be made on current. The company pays the cost of the promotion of the Bill, and undertakes to provide reasonable security to the satisfaction of the Council. The security question has just recently threatened to wreck the whole scheme, the Council wishing for something "more tangible and lasting" than the security of public companies. One security of £10,000 appears to represent the terms of the agreement, but at the meeting of the Council this week, it was stated that "proceedings" had been started against the company, but that these had been stopped as the company had agreed to a proposal for the execution of a bond by themselves, and the Electric and General Investment Co., of approved form and the deposit of £10,000 of their second debenture stock. The question of security has, therefore, now been settled. The tramway line proposed will only run half way through Beckenham.

The Council is also considering "proposed terms for the extension of the British Insulated and Helsby Co.'s lease" of the electric light undertaking.

Berlin Electric Railways.—It is reported from Berlin that the Traffic Committee of the City Council has recommended the construction by the municipality of an underground railway traversing the city from north to south, at a cost of £2,500,000.

Birmingham.—Discussion on the proposed tramway system was commenced at Tuesday's Council meeting and adjourned till July 5th. Sanction was given to borrow £7,610 for extensions to, and £32,000 for the electrification of, the Small Heath route. The chairman of the Committee, Alderman Beale, in describing the scheme, stated that they would still require to adhere to the 3 ft. 6 in. gauge on account of the many narrow streets. He was also of opinion that people wanted to get into the centre of the city, and not from one district to another, hence the recommendation to have terminal loops. The hilly character of the city portion was also given as another reason why through routes were not recommended. The residents in Edgbaston, skirting the Harborne Road, are again, as in 1902, raising objection to the Harborne route.

Coseley.—The U.D.C. has received a letter from the South Staffordshire Tramways Co., intimating that it had been decided to discontinue the service of steam tramcars in the district on the 15th inst., until such time as the lines were reconstructed and electrically equipped. A deputation of the Council was appointed to wait upon the manager of the company to discuss the Council's position in relation to the matter.

Crewe.—In reply to an offer from a private company to seek powers to construct electric tramways in the town, the T.C. has replied, pointing out that the Council has not abandoned, but only postponed, its application for a light railway order.

Electric Signalling on the Midland.—A Nottingham paper reports that in order to test the efficiency of electrical as against ordinary mechanical interlocking for the operation of railway signals and points, the Midland Railway Co. have placed a contract for the equipment of a section of their lines at Derby with all electric signalling apparatus.

Kirkcaldy.—Treasurer Kilgour has issued his financial statement in connection with the Corporation electric tramways and lighting. The whole tramway system has not been in operation during the complete year. The statistics show the total number of car-miles to have been 301,779; the total number of passengers carried, 2,770,936; the total number of units used on the tramways (at 1½d. per unit), 395,071; population last census, 34,063; number of times population carried, 81·3; units per car-mile, 1·309; passengers carried per car-mile, 9·1; and average traffic receipts per passenger, ·87d. The total traffic receipts were £9,934. No assistance from the rates will be necessary. The supply of electricity for lighting and power has exceeded anticipations. A surplus is also shown on this department of the undertaking.

London.—CAMBERWELL.—The B.C. is to ask the L.C.C. to obtain powers next session for a tramway from a point in the authorised line from Camberwell Green to Forest Hill, near the junction of London Road and Sydenham Hill, along the last named to the Crystal Palace.

New South Wales.—The report of the Railway Commissioners for the quarter ended March 31st, says that for the three months the tramway earnings show an increase of £9,490. The expenditure also increased by £6,786, the result being a net improvement of £2,704.

Northwich.—The R.D.C. has received from a Manchester firm an intimation that application is to be made by a syndicate for powers to construct an electric tramway from Tarporley to Winsford. The Council has decided to dissent from the application.

Paisley.—The first section of the electric tramway system was opened for traffic on Monday. The section extends from the Cross to Hawkhead, the terminus of the Glasgow system, a distance of about one mile. There was no formal opening. The cars are capable of seating 22 passengers inside and 33 outside. They were built by the British Electric Car Co., of Manchester. The fares are 1d. from the Cross to Hawkhead Road, and ½d. from Hawkhead Road to McKerrall Street and McKerrall Street to the Cross. The ½d. fares are an innovation in the town. The service is from 7.30 a.m. to 11 p.m., cars running at 10 minutes' interval. The cars are to run on Sundays.

Poole.—The arbitration case between the Poole and District Electric Traction Co. and the Bournemouth Corporation was again adjourned on June 6th, after having already occupied the attention of the appointed tribunal four days. The resumption is fixed for to-morrow, Saturday, the 18th inst., when, it is believed, the first of the witnesses on behalf of the Corporation will be heard. The company's claim amounts to £427,619; £224,800 of this represents the estimated value of their existing (a single) line, which the Corporation has agreed to purchase, and which has a total length of 3 miles 6 furlongs ·06 chains. The remainder relates to running powers over the Bournemouth municipal lines, and various acquired rights and privileges.

Single-Phase Traction.—The electric traction experiments on normal gauge railways made since August 15th of last year by the Union Elektrizitäts Gesellschaft, Berlin, with their high pressure single-phase alternate current system on the Niederschönweide Spindlersfeld line have resulted in this line being electrified; trains comprising two motor-cars and three trailers have been run since June 1st. The motor-cars are placed at the ends of the trains. No increase of the running speed is contemplated for the present, the intention of the railway department being to obtain reliable data as to the working cost of the new system.

Wakefield.—Steady progress is being made with the laying of the electric tramway between Horbury and Ossett market place, of the Wakefield and District Light Railway Co. The metals are in position for a considerable distance, and standards are now being erected.

Wolverhampton.—The Wednesfield road section of the tramway scheme is now nearing completion, and a start has been made with the construction of the track to Bushbury from the Waterloo Road. Instructions have been given to electrically equip the loop line in Queen Square; and an order has been given to the Lorain Steel Co. for the electrical equipment of the extensions of the Wednesfield Road route, conditional upon the Corporation Bill, 1904, receiving the Royal assent. An order has been given to the same company for the execution of special work in connection with the car-shed extensions, at a cost of £303 8s. 4d.

Yorkshire Woollen District.—Arrangements are being made by the Yorkshire (Woollen District) Electric Tramways, Ltd., to convey passengers from Dewsbury to Huddersfield, on the occasion of the holding of the Yorkshire Agricultural Show at the latter place. Electric cars run from Dewsbury to the Mirfield boundary, a distance of nearly three miles. From here passengers will be carried in wagonettes to the Show ground, and the charge for the whole journey will be 5½d.

Nigeria.—The land telegraph line connecting Lagos with Forcados, Southern Nigeria, is to be opened for traffic in a few days. Old Calabar has also been connected by telegraph with England.

TELEGRAPH AND TELEPHONE NOTES.

German Rivalry with British Cables.—The five years' opposition of the Eastern Telegraph Co. to the projected Costanza-Constantinople submarine cable has been unsuccessful, as the Porte has now signed the convention which allows the German company to proceed with the work. It appears that the East European Telegraph Co. was formed in Berlin in 1899 for the purpose of establishing a cable between the Roumanian harbour of Costanza and the Turkish capital. The constitution of the company formed the subject of an agreement between Germany and Roumania for a direct telegraphic connection between Berlin and Bucharest, together with an extension to Costanza and Constantinople. The Roumanian Government guaranteed a yearly subsidy of £2,000, and undertook for a period of 30 years not to grant any other concession for the laying of a cable between that country and Turkey. The landline was speedily established, but the Eastern Telegraph Co. opposed the concession for the Black Sea cable on the ground that it possesses the exclusive right of laying cables on Turkish territory, whilst at the same time considerable competition would be offered by the new cable to the Eastern Co.'s line between Odessa and Constantinople. This opposition has, however, been futile, as the negotiations have just been decided in favour of the German company, which will begin the laying of the cable immediately. It is noteworthy that the Costanza-Constantinople cable will form the continuation of a long landline connection which will extend from Berlin *vid* Breslau, Bucharest, Byganza and Bagdad to the Bassora on the Schat-el-Arab, that is to say, to the Persian Gulf. The sections of this line in Asia Minor will also be brought into rivalry with those of an English company, the Indo-European Telegraph Co., whose lines pass *vid* Odessa to Kersb, Tiflis and Teheran, and proceed to the Persian Gulf.

Glasgow Corporation and a Telephone Patent.—We glean the following from a report in the *Glasgow Herald*, of June 3rd, respecting the action of the Glasgow Corporation in the matter of a telephonic device invented by one of the members of its telephone department staff:—

"The minutes of the Telephone Committee stated that 'it was agreed to bear the cost of the provisional protection of an improvement of telephone apparatus by the assistant general manager, on condition that the Corporation will, free of all charge for royalty, have the use of it for their telephone system.'

"Mr. Connell asked what was the form of the improvement, and if the Corporation was to punish the man for improving his department, and rob him of all his rights and financial benefits.

"Mr. James Alexander, who had moved the adoption of the minutes, said the Corporation were to pay all expenses, which would not be a great deal, and the Corporation would get the benefit. This was a mutual arrangement between the Corporation and Mr. Macphee.

"Mr. Connell asked if he understood that Mr. Macphee would derive no benefit.

"Mr. Alexander: He does not want any.

"Mr. Connell said he would move that this minute be remitted back. He considered the arrangement was a gross injustice to a man who, by his brain and genius, devised this improvement. It was the last thing he would have expected that the Corporation should take a mean advantage of that kind. He would have considered that the Corporation would afford every possible inducement to every gentleman in its service in bringing out any improvement or invention his brain could devise. As to the mutual arrangement, it was as between a single individual and a practically omnipotent Corporation. He held that was an unjust agreement.

"Mr. Cohen seconded Mr. Connell's amendment.

"Bailie Stewart said that it had been a practice of the Corporation for many years that, when any of their officials brought out an invention, the Corporation received the advantage of it free of royalties. This was an equitable arrangement, because officials had facilities for carrying out experiments in the time and with the material of the Corporation.

"Mr. Hugh Alexander pointed out that Mr. Macphee had brought out this invention in the time and with the material of the Corporation, and he had not even suggested that the Corporation should pay the cost of the patent. On the contrary, he believed that he was amply paid by the facilities he had had for doing the work.

"The minutes were approved by a large majority."

A New Cable in the Far East.—The *Frankfurter Zeitung* learns that a German-Dutch financial group has been formed for the purpose of financing the establishment of a telegraph cable between the Dutch Indian island of Menado and Guam and Shanghai. It is stated that the new cable is to form, in connection with the American cable, a means of communication with the Far East, which will be independent of English influence. The cable company to be constituted will have a share capital of £350,000, and a 4 per cent. bond issue amounting to £362,500, and large subsidies are said to be assured to the company both by the German and Dutch Governments. Among the German group associated with the scheme may be mentioned the Disconto Gesellschaft, the Darmstadt Bank, Dresden Bank, and the Schaaffhausen Bank Verein, while the Dutch institutions comprise the Amsterdam Bank and the Netherlands Handels Maatschappy.

The Telegraph Cable Export Trade.—The spasmodic character of the export trade of this country in telegraph cable and apparatus connected therewith is well shown in the returns for May, during which month the shipments attained a value of £171,760, the largest, so far, this year, and comparing with only £45,429 in the preceding month, and £100,392 in May of last year. Notwithstanding the relative briskness in May, the year, so far, has been unusually quiet, the value of the exports during the first five months only amounting to £461,025 as compared with £1,362,133 in the corresponding period of 1903, and £840,319 in the first five months of 1902.

Telegraphic Interruptions and Repairs:—

	Cables.	Interrupted.	Repaired.
Dominica-Martinique		May 5, 1904	
St. Lucia-Martinique		May 7, 1904	
Trinidad-Demerara No. 1		Aug. 27, 1901	
Cayenne-Pinheiro		Aug. 18, 1902	
Anjer-Kallanda		Aug. 2, 1902	
Reissa-Issa (Yemen)-Camaran		Oct. 23, 1902	
Tarifa-Tangier		Jan. 18, 1904	
Closed: Nagasaki-Vladivostock		Feb. 15, 1904	
Closed: Port Arthur-Chefu		Feb. 18, 1204	
Foochow-Formosa		Feb. 11, 1904	
Gibraltar-Tangier		May 17, 1904	June 8
Acora-Lagos		June 1, 1904	
Nagasaki-Fusan		June 7, 1904	
	Landlines.		
Seoul-Masampo		Feb. 13, 1904	
Seoul-Gensan		Feb. 13, 1904	
Anju-Ping-Yang		Feb. 25, 1904	
Ninguta-Vladivostock		March 2, 1904	
Dominican lines		May 26, 1904	

Wireless Telegraphy.—It appears from a report of an interview with Count Arco, a director of the German Wireless Telegraph Co., that the "Telefunken" system is to be used in connection with the forthcoming international motor-car race for the Gordon-Bennett Cup on the Saalburg. The company has provided three stations, one of which is stationary, and the other two are portable. It is proposed to transmit to the judges and visitors at the principal station messages recording incidents during the progress of the race, which will be run over a course of about 310 miles.

When the mail left Cairo on 2nd inst., two Lloyd's officials were superintending the construction of a station for Marconi's wireless telegraphy at Port Tewfik. The station is situated near the Quarantine Office, and will, for the present, communicate with Port Said, and with ships in the Red Sea, having their own instruments on board.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bridgend.—June 18th. Telephone and fire-alarm installation for the Angelton and Parc Gwyllt Asylums. See "Official Notices" June 10th.

Bristol.—June 20th. The Electrical Committee invites tenders for the construction of switch-rooms, at the Temple Back Electricity Works.

Bulgaria.—August 13th. The Municipal Authorities of Philippopolis are inviting tenders until August 13th for the concession for the electric lighting of the town and for the construction and working of an electric tramway.

Cardiff.—June 23rd. Motor tower wagons for the tramways department. See "Official Notices" to-day.

Clyde.—July 25th. Two 32-ton electric coaling hoists for Clydebank Dock. See "Official Notices" to-day.

Deptford.—June 21st. Two 25-KW. steam dynamos, booster and switchboard, for the electric lighting of the new Town Hall. See "Official Notices" May 27th.

East Ham.—June 21st. Wiring and fittings for the new technical college. See "Official Notices" to-day.

Edinburgh.—June 27th. Electric supply cables for one year. See "Official Notices" to-day.

Erith.—July 11th. Rails, fishplates and bolts; permanent way construction for the U.D.C. tramways. See "Official Notices" June 10th.

Exeter.—July 1st. One 200-KW. engine and generator, condenser, &c. See "Official Notices" to-day.

Finchley.—June 20th. One 350-KW. high speed engine and dynamo. See "Official Notices" June 10th.

Finchley.—June 20th. Adaptation of light railway poles for street lighting. See "Official Notices" to-day.

Fire Alarms.—June 22nd. Tenders are invited for a number of fire alarm installations on the May-Oatway system in Scotland. See "Official Notices" to-day.

Heston and Isleworth.—July 4th. Electricity meters for the U.D.C. See "Official Notices" to-day.

Isle of Thanet.—Electricity meters for the Isle of Thanet Electric Tramways and Lighting Co. See "Official Notices" June 10th.

Johannesburg.—July 4th. Cables, conductors, and accessories. See "Official Notices" May 13th.

Johannesburg.—July 29th. Steel work for car-shed buildings, and bridge over railway. See "Official Notices" to-day.

Leigh.—June 21st. One 350-KW. steam-driven set and switchboards. See "Official Notices" June 3rd.

London.—July 12th. Three 3-ton electric travelling cranes and two electric locomotives for the wharf of the Greenwich power station of the L.C.C. See "Official Notices" to-day.

London.—July 12th. The L.C.C. wants tenders for various overhead travelling cranes, and lifting tackle for Greenwich station. See "Official Notices" to-day.

Loughborough.—June 25th. Cable, switchboard and piping. See "Official Notices" June 10th.

Manchester.—June 30th. Motors, motor starters, cables, troughing, fuse boxes, &c. See "Official Notices" to-day.

Newport.—Cables. See "Official Notices" to-day.

Penrith.—July 5th. Two oil or gas engines and dynamos; switchboard and boosters; battery and mains for electricity supply. See "Official Notices" to-day.

Rochdale.—June 27th. Removal of lighting and traction switchboards to new switchroom; reconstruction of lighting switchboard, &c., at the electricity works. See "Official Notices" to-day.

Rochdale.—July 1st. One 412-KW. steam dynamo. See "Official Notices" to-day.

Shanghai.—July 30th. The Municipal Council invites tenders for a 24-mile electric trolley line concession. Particulars from J. Pook & Co., 63, Leadenhall Street, E.C., the London agents of the Council. See "Official Notices" May 13th.

Spain.—July 15th. The Spanish Ministry of Public Works in Madrid is inviting tenders until July 15th for the concession for the construction and working of an electric tramway between Sarria to the foot of Vallvidrera mountain (province of Barcelona). Tenders are to be sent to El Ministerio de Obras Publicas, Madrid, whence particulars may be obtained.

Stepney.—June 20th. Electric light installation at the Public Baths. See "Official Notices" May 27th.

Stepney.—June 28th. Electric wiring for the public baths. See "Official Notices" June 10th.

St. Pancras.—June 28th. Cables and carbons. See "Official Notices" to-day.

Switzerland.—June 25th. Tenders are being invited until the 25th inst. by the Swiss Military Authorities at Berne for the supply and installation of 250 lamps and the necessary conductors for the electric lighting of the underground chambers at the Fort of Dailly. Tenders are to be sent to Le Departement Militaire Suisse (Service de Genie, Section des Fortifications), Berne, whence particulars may be obtained.

Walthamstow.—June 23rd. Three Westinghouse gas engines, three C.C. dynamos, and other plant for the electricity works. See "Official Notices" June 10th.

West Ham.—The Corporation on Tuesday authorised the architect to obtain tenders for the wiring and supply of electric light fittings at the West Ham Park Schools.

Wigan.—June 21st. Twelve bogie cars and equipments. See "Official Notices" June 10th.

Zanzibar.—Electric lighting and traction are to be introduced throughout the town and port of Zanzibar. Particulars from A. S. Rogers, Regent and Prime Minister to the Sultan of Zanzibar, Zanzibar.

CLOSED.

Bradford.—The Electricity Committee has accepted the tender of Messrs. Holmes & King, Ltd., for the construction of a storage reservoir at the Valley Road Electricity Works, at £13,964 10s.

Bristol.—The Electrical Committee has placed an order for transformers with Messrs. Burnand & Co.

Fulham.—The B.C. has accepted the tender at £343 14s. of the National Electric Construction Co., Ltd., to make alterations in the installation of the electric light at the baths, in connection with which installation, it will be remembered, a fatal accident occurred some time ago.

Glasgow.—The Electricity Sub-Committee has accepted the following tenders:—

(*a*) Callender's Cable and Construction Co., for low-tension cables.
(*b*) Messrs. W. T. Glover & Co., for high-tension cables.
(*c*) Messrs. Crompton & Co., for 150,000 pair of 18 mm. cored and 12 mm. solid carbons, and 15,000 pair of 16 mm. cored and 11 mm. solid carbons.
(*d*) Mr. D. M'Naughton (agent for Fabius Henrion, Nancy), for the same quantities of similar carbons.
(*e*) The Reason Manufacturing Co., to the extent of 100 3-ampere meters.
(*f*) The Electrical Co., Ltd., to the extent of 25 3-ampere, 50 5-ampere, and 25 10-ampere meters; and
(*g*) Chamberlain & Hookham, Ltd., to the extent of 400 3-ampere, 600 5-ampere, 100 10-ampere, 100 25-ampere, and 50 50-ampere meters, reserving under the last-mentioned item the right to the Corporation to order such further quantities of any of the sizes of meters therein specified as they may require during the year.

The offer by the Burrowfield Iron Works, Ltd., to supply the necessary materials and tackle, and execute the skilled labour for the alteration required on the joisting which is to carry the overhead water tanks about to be erected at the Pollokshaws Road generating station has been accepted.

The Committee has also accepted the offer by the British Westinghouse Electric and Manufacturing Co., Ltd., to provide additional apparatus required for the sub-station switchboards for £159.

London.—The London County Council has received the following tenders for the supply and erection of the main switchgear required for the first part of the power station at Greenwich:—

British Westinghouse Co. (recommended for acceptance)		£22,910
British Thomson-Houston Co.		25,591
Electric Construction Co.		32,000
Elliott Bros., London		36,706
Dick, Kerr & Co.		37,019
Electric and Ordnance Accessories Co.	(incomplete)	3,627
Cowans, Ltd., Manchester	(incomplete)	3,881

The undernoted tenders have also been sent in for the supply and erection of 10 additional water-tube boilers at the Greenwich power station:—

Stirling Boiler Co.	(recommended	£16,271
Richardsons, Westgarth & Co.		18,181
Richard Hornsby & Sons		18,131
J. Musgrave & Sons		18,131
B. R. Rowland & Co.		18,845
Babcock & Wilcox, Ltd.		18,978
Stirling Co., Manchester and U.S.A.		23,200
John Thompson, Wolverhampton		27,700

In each of the above cases, the sub-letting of various portions of the work is proposed by the successful tenderer.

Manchester.—Messrs. Higginbottom & Mannock, Ltd., crane and hoist makers, Manchester, have secured the order for 20 movable electric Goliath jib cranes to lift 30 cwt. each, 34 ft. radius, 57 ft. high, for the equipment of the new Salford Docks belonging to the Manchester Ship Canal Co.

Purley.—The contract for wiring and fitting at the Purley New Congregational Church has been given to Messrs. J. & T. Robinson, of Brixton Hill. The three tenders sent in were exceptionally close, viz.:—

Messrs. J. & T. Robinson	(accepted)	£185	5	0
Messrs. G. Candler & Sons		184	0	0
Messrs. Julius Sax & Co.		183	18	6

Wolverhampton.—The following tenders have been accepted by the T.C.:—

Lorain Steel Co., special work in connection with the car-shed extension (£303), and electrical equipment of the extensions of the Wednesfield Road track.

Bellias-Morcom, Ltd., and the Electric Construction Corporation, Ltd., 300-KW. steam generating set, £2,874.

The T.C. has also accepted the following tenders:—Of Mr. H. Gough, of Wolverhampton (£144) for coal bunkers at the electricity station; of Hy. Willcock & Co. for the erection of the extensions necessary at the car depôt, Cleveland Road, at £2,587; that of the British Thomson-Houston Co., at £2,460 (trucks), for four single-deck cars and six double-deck cars; also a tender of Messrs. Milnes, of Hadley, for car bodies.

Worcester.—The T.C. has accepted the tender of Messrs. Reavell & Co., Ltd., for the supply of an electrically-driven air compressor, at £190.

FORTHCOMING EVENTS.

Saturday, June 18th.—Annual Athletic Race Meeting of the Arc Works Club (Crompton & Co., Ltd.) at Chelmsford.

Saturday, June 25th.—At 3 p.m. Junior Institution of Engineers. Visit to the Chelsea generating station of the Underground Electric Railways Co., Lot's Road, Chelsea.

Tuesday, June 28th.—9 to 11.30 p.m. Conversazione of the Institution of Electrical Engineers at the Natural History Museum, Cromwell Road, S.W.

Saturday, July 9th.—Junior Institution of Engineers. The visit to Dover to inspect the Admiralty Harbour Works, announced for Saturday July 2nd, has been postponed to Saturday, July 9th.

NOTES.

Tesla in the "Daily Mail."—Marvels beyond belief—*our* belief, at any rate—are to be accomplished by Mr. Nikola Tesla by-and-by, according, of course, to the *D. M.*:—

"An enormous mushroom-shaped tower has just been completed at Wardencliffe, Long Island, by Mr. Nikola Tesla, the distinguished electrical inventor. From this tower Mr. Tesla is now preparing to put into operation the most daring and amazing scheme ever conceived in the development of wireless telegraphy.

"For over four years Mr. Tesla has been hard at work almost day and night experimenting and endeavouring to make his marvellous theory practicable. From time to time during that period he had intimated vaguely the immensity of his plan, and the equally tremendous results that would follow its introduction, and now, at last, he has announced his preparedness to put his theories to their first practical test.

"For a large part of the work already done Mr. Tesla is indebted to the generosity of Mr. J. Pierpont Morgan, who is extremely interested in the scheme."

Poor Mr. J. P. M.

"Briefly explained, Mr. Tesla's assurances of what we may expect in the next few years are as follows:—

"A ceaseless day and night service of millions upon millions of volts of electricity from the Canadian Niagara Power Co.'s electric power plants at Niagara Falls to the Wardencliffe tower, the electric power being forwarded from there by Tesla's wireless system to New York City for the purpose of illuminating the entire metropolis, running elevated and underground trains and tramway cars, operating lifts, motor-cars, trucks, and ferry-boats, furnishing heat, and even winding up clocks and making them keep perfect time by a system of half-hourly regulation.

"Each will distribute about 10,000 H.P. of wireless electricity under a tension of one hundred million volts. Mr. Tesla declares that he is able to produce and handle that much with perfect safety from one tower.

"Among his other schemes Mr. Tesla proposes a perfect system of world-wide wireless telegraphy through which widely separated friends will be able to converse instantaneously and without the slightest danger that their wireless conversations will be overheard by a third person.

"Little instruments about the size and shape of a watch will be carried in the vest pocket and will record market quotations, races, and important news features.

"Another little watch-like instrument is one with a dial face by means of which the wearer can transmit and receive wireless messages to and from friends many miles away. Watches of both sender and receiver will be keyed to a certain pitch to prevent their communications from going astray or falling into the watches of disinterested third persons."

We envy the *D. M.'s* good luck in coming into possession of these wonderful items of news; but we fear they are *bad* news.

Appointments Vacant.—Lecturer in mathematics for Birmingham Municipal Technical School (£175); electrical laboratory teacher (evening classes) for the G.E. Railway Institute, Stratford; a teacher in electric lighting and wiring is required for one evening per week for Finchley; a teacher is wanted for an electric lighting class at Enfield (one evening per week); electricity and tramway clerks, and switchboard attendant, for Swindon Corporation.

Royal Society.—The following were among the papers down for reading at yesterday's meeting:—

Sir Norman Lockyer, K.C.B., F.R.S., and Dr. W. J. S. Lockyer. "A Probable Cause of the Yearly Variation of Magnetic Storms and Auroræ."

Sir William Crookes, F.R.S. On the "Action of Radium Emanations on Diamond."

The Wages of Tramway Employés.—On Sunday a meeting under the auspices of the Amalgamated Association of Tramway and Vehicle Workers of the United Kingdom was held at the Coop Hall, Wolverhampton. Councillor James Whittaker occupied the chair, and there was a fair attendance of tramway men. Councillor G. T. Jackson, of Manchester, the general secretary of the association, addressed the men on the value of organisation and of becoming members of the union, and traced the history and development of the association with which he was connected, and which had a capital of £17,000. If they took 30 Corporations, the minimum average wage earned by the drivers was 6 64d., and with that they could not be satisfied, for to earn a decent wage a man was obliged to put in 60 hours a week. He suggested that the Tramways Committee of Wolverhampton should better the conditions of the men. He did not believe in a minimum and a maximum, but a standard rate of wages being paid. The minimum wage in Wolverhampton for a driver was 5½d. per hour, and at the end of four years he got 6½d. The conductors started at 4½d. per hour, and at the end of five years received 5½d. These conditions, the speaker argued, compared unfavourably with those in many other towns. The meeting concluded without any resolution being submitted.

London County Council.—The Finance Committee presented a report at Tuesday's meeting of the Council in reference to the proposed borrowing of money by the Marylebone Borough Council. It appeared that in consequence of orders made by the Courts, for immediate payment to the Metropolitan Electric Supply Co. of certain sums for new capital expenditure incurred in connection with the Marylebone undertaking, the Borough Council had found it necessary to increase by £50,000 the amount for which power to borrow is sought, making the total sum to be borrowed £1,415,000. The Borough Council had asked the County Council to take power to advance the increased amount, and on the recommendation of the Committee it was decided to take steps to amend the Council's Money Bill of 1904 in the direction indicated. As the Borough Council was desirous of completing the purchase as soon as possible, the County Council also resolved without any discussion to advance on loan the sum of £1,415,000 on certain conditions on or before October 31st, 1904. This decision depends for fulfilment upon the furnishing of the necessary consents and evidence, and on the passing of the Borough Council's Bill, and of the County Council's Money Bill of the present session.

The Council adjourned for a week the consideration of a report by the Highways Committee recommending that application should be made to Parliament in the session of 1905 for power to construct tramways over Westminster Bridge, and along the Victoria Embankment, and the portion of the subway already authorised to the north side of the Strand, together with the formation of a connection between the proposed tramways, and the tramways in Lambeth Palace Road.

It was decided to grant a loan of £10,634 to the Hammersmith Borough Council for electric lighting works, including £3,670 for meters. Approval was given to plans for works in connection with the erection of coal bunkers, boilers, and conveyors at the Bermondsey Borough Council generating station.

Fatalities.—It is reported that while cleaning an electric arc lamp at Cardiff on Thursday last week, Donald Watson received a severe shock. First aid was rendered, and the injuries were not serious.

We regret to learn that there has been another fatality on the Liverpool-Southport electric railway, through a workman (Flood, aged 19) who was on his way to Formby power station catching his foot against the live rail. He became insensible immediately, and died within half-an-hour. A companion tried to rescue him, but he likewise received a shock, though not a fatal one; he recovered after artificial respiration measures had been applied. The two men are reported to have been trespassing, as they were proceeding to the station in search of employment. The inquest into the cause of Flood's death was opened on Thursday last week at Formby. The evidence supported the above statements, and showed that deceased had to climb over a 6 ft. hurdle fence in order to get on to the line Artificial respiration was of no avail in Flood's case, and he died from shock and heart failure. The resident electrical engineer at Altcar station (Mr. H. E. O'Brien) stated in his evidence that if a person kept to the crossing there was not the slightest danger. Where anyone had the slightest right to be, the "live" rails were protected. The Coroner, addressing the jury, said that notwithstanding all the provisions that scientific people were continually making for the protection of life, fatalities were still occurring. They could not provide for every contingency in this world. He did not hold any brief for the L. and Y. Cc., but he did not want to be either partial or, on the other hand, prejudiced against them; and that was the way the jury ought to look at the matter. For their own benefit and that of the public the company had electrified the line, and he thought they ought to take for granted that the company had done the best they could so far as engineering skill was concerned, and at the same time taken every precaution to protect the travelling public from the dangers connected with the use of electricity. If the jury could make any suggestions for the better protection of life in the future they might do so. The jury found that the death of Flood was purely accidental.

It is reported that a porter on 13th inst. slipped and came in contact with a live rail on the N.E. Railway's electrified section at Manors Station, near Newcastle. Death was instantaneous. The victim was much burned about the head and neck.

On 9th inst., at the British Insulated and Helsby Cable Works, Prescot, a young man named Molyneux (18) was minding a machine which winds copper into coils at the rate of 1,000 ft. per minute, when a nut on the cylinder of the drum flew out, and struck him on the right temple, knocking him to the ground in an unconscious condition. He died in a short time without regaining consciousness.

Corporations and Standardisation.—The Gas Committee of the Glasgow T.C. has recommended that a subscription of £12 10s. be given as a donation towards the expenditure in connection with the work now being carried on in London by the Engineering Standards Committee, on the understanding that the tramway, electricity, and water departments of the Corporation subscribe a similar sum in order to make the donation from the Corporation one of £50. The donation is the result of an application made by the President of the I.E.E. and the chairman of the Sub-committee on Generators. The Electricity Committee of the T.C. has agreed to the proposal.

Electricity Works Statistics.—We are indebted to Mr. J. A. Robertson, burgh electrical engineer, Greenock, for kindly pointing out that the capital expenditure at his works is upwards of £80,206, not £40,424 as given in our tables.

Water Power in Italy.—The municipality of Turin has decided to expend £12,000 for the purpose of acquiring a water power concession which proposes the utilisation of the falls of the Dora mar Salbertrano, in the Susa Valley, with the object of erecting a central station for the supply of Turin. It is estimated that 8,000 H.P. is available, and a committee has been appointed to prepare a scheme for submission to the town council. If carried into effect the works will be brought into competition with the undertaking of the Alta Italia Electricity Co., which hitherto has not proved financially prosperous, although recent prospects have

been more favourable. It is thought that the action of the municipality has been dictated by the apprehension that the Alta Italia Co., which recently acquired an additional water power concession, wishes to secure a monopoly.

Earth Currents.—Last month M. E. Guarini propounded his views on earth currents before the Belgian Astronomical Society. The lecturer suggested that a current was produced in the atmosphere by the rotation of the earth round the sun, and that this induced current further induced a current in the reverse direction in the crust of the earth, the direction of the terrestrial current being opposite to the direction of rotation of the earth. Such a current would be capable of producing the observed magnetic field of the earth. It is not clear, however, how a continuous current can be induced by a continuous current. M. Guarini considers that some day the earth currents may be applied to industrial purposes.

Trolley Omnibuses in Berlin.—A service of trolley omnibuses, in which the current is conveyed to the motors by means of overhead wires, is on the point of being established in Berlin between Johannisthal and Nieder Schöneweide. The 'buses, each of which will accommodate 16 persons seated and six standing, are being made by the Allgemeine Co., and the weight ranges from 3½ tons to 4 tons. It is possible for the vehicles to attain a maximum speed of 12½ miles an hour. The introduction of trolley omnibuses is merely a temporary expedient, as an electric tramway is to be constructed to connect the districts in question as soon as the local conditions permit of the work being executed.

The Electrical Standardizing, Testing and Training Institution.—Prof. C. A. Carus-Wilson, M.A., M.I.E.E, will commence a special course of lectures to the senior students of the above institution upon "Direct Current Motor Construction," on Thursday next, June 9th.

British East Africa.—Mr. Clement Hirtzel, the concessionnaire for the supply of electrical energy for the lighting, &c., of Nairobi, has stated in an interview published by the *Anglo-African Argus*, that he anticipates a large demand for lighting and power. Three thousand lights, he estimates, will be required at once. His idea is to harness some falls about 18 miles from Nairobi and use them for electrical power transmission—in the same way that the Victoria Falls in Rhodesia are proposed to be utilised. "The power could be used," said Mr. Hirtzel, "for ploughing, mills and pulping. . . . My intention is to put up a telpherage line for about 18 miles."

American Institute of Electrical Engineers.—The annual meeting of this organisation was held at New York City on May 17th and 18th. The annual report shows that the Institute has now more than 3,000 members. The ordinary receipts for the year ending April 30th, 1904, amounted to $40,986, and the ordinary operating expenses were $36,394. The new president is Mr. John W. Lieb, jun., associate general manager of the New York Edison Co. The new vice-presidents, as elected, are:—Mr. W. E. Goldsborough, electrical director of the St. Louis Exposition; Mr. J. C. Carty, chief engineer of the New York Telephone Co.; and Major Samuel Reber, electrical engineer, War Department, Washington. The four newly elected managers are:—Mr. Henry G. Stott, superintendent of motive power, Manhattan Elevated Railroad; Mr. L. A. Fergusson, general superintendent of the Chicago Edison Co.; Mr. Schuyler S. Wheeler, president of the Crocker-Wheeler Electric Co., of Ampere, New York; and Mr. James S. White. Mr. Ralph W. Pope, who has been secretary since 1885, continues in office, as does also the treasurer, Mr. George A. Hamilton, of the Western Electric Co.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—A pleasant function was held at the Brompton and Kensington Electricity Works last Friday evening, when Mr. W. J. ALLBRIGHT, who is leaving to take up the post of resident engineer to the Crystal Palace District Electric Supply Co., Ltd. (recently acquired by the Blackheath and Greenwich District Electric Light Co., Ltd.), was presented with an illuminated testimonial signed by about 60 of the staff and employés, together with a gold watch. Mr. H. W. Bowden, the manager and chief engineer, in making the presentation, referred in eulogistic terms to Mr. Allbright's ability and the regret which his departure caused in all departments.

Bangor T.C. has increased the salary of the electrical engineer by £40 a year.

Mr. J. ALLEN has been appointed mains foreman at the St. Anne's electricity works.

The Dudley Corporation Electrical Committee have re-engaged Mr. WILSON, electrical expert for another year, but his commission on new plant laid down is to be lowered from 5 to 2½ per cent. As the arrangements with the Tramway Committee are not yet complete, the Committee do not consider it is desirable yet to appoint a borough electrical engineer.

Last Friday Mr. WILLIAM FRISBY, chief assistant at the Colchester Corporation electricity works, was, in view of his approaching marriage, presented with a handsome silver tea service, subscribed for by the staff of the works. The presentation was made by Mr. A. R. Sillar, the borough electrical engineer.

Mr. A. G. H. DAVIS has resigned his position on the staff of the Newcastle Electric Supply Co. in order to take up the appointment of chief shift engineer at the City of Exeter electrical works, to which he was appointed by the Committee out of 35 applicants.

The employés of Motherwell Electricity Department went for their first annual outing last Saturday. They went to Brodick, on the Isle of Arran, and had excellent weather. Mr. S. WILLIAMS is the new chief of the department.

Mr. W. J. S. JONES (late of Queensland), engineer to the works department of the County of Durham Electric Power Supply Co., was married last week to Miss Sallie, second daughter of Mrs. and the late R. H. McBryde, of Newcastle. The ceremony took place at the Heaton Road Presbyterian Church, Newcastle. On the 1st inst. Mr. Jones was entertained at luncheon by his colleagues at the Gateshead Power Station, and was presented with a case of cutlery and a silver fruit dish. The chair was taken by Mr. W. J. Charlton, secretary to the Electrical Power Distribution Co., Ltd., the vice-chairman being Mr. A. S. Eeslemont, managing engineer. The presentation was made by Councillor J. W. Laws.

Electric Tramway Officials.—Mr. JOHN BRINDLE, late manager of the Bury, Rochdale and Oldham Tramway Co., has been presented by the employés with a writing desk.

General.—Mr. G. E. STOCKENS, district manager of the National Telephone Co., will shortly be leaving Canterbury to take up an appointment at Aberdeen, where he will have the supervision of a large district in the north of Scotland.

Mr. COSTAR, late of the British Insulated and Helsby Cables, Ltd., has now joined the staff of the St. Helens Cable Co., Ltd., of Warrington, as dry core and paper specialist.

NEW COMPANIES REGISTERED.

London Electron Works Co., Ltd. (81,209).—This company was registered on June 10th, with a capital of £26,000 in £10 shares, to acquire and take over as a going concern the business of a metallurgist and electro-chemist now carried on by A. de Back at Regent's Dock, Horseferry Road, Limehouse, as the "London Electron Works Co.," and to carry on the business of iron, steel, tin, lead, brass, and general metal masters, makers, workers, converters, and founders, smelters, engineers, tinplate workers, smiths, metallurgists, electrical and electro-chemical engineers, merchants, manufacturing chemists, &c. The first subscribers (each with one share) are:—A. de Back, Regent's Dock, Horseferry Road, Limehouse, electro-chemist; T. Zettel, The Priory, 2, Crystal Palace Road, Sydenham, Doctor of Philosophy; E. Kalimus, Villa Rosette, Cavendish Road, Sutton, Surrey, flour factor; E. Back, 1, Kolonrathring, Vienna, manufacturer; R. Richards, 1, Stubenring 18, Vienna, manufacturer; J. Zettel, 1, Rathhausstrasse 15, Vienna, official stockbroker; E. Duschnitz, 1, Volksgartenstrasse, Vienna, Doctor of Laws; and C. Duschnitz, 1, Bartensteingasse 9, Vienna, manufacturer. No initial public issue. The number of directors is not to be less than two nor more than five; the first are A. de Back and Dr. T. Zettel, each of whom may retain office while holding 100 shares; qualification of subsequent directors, £1,000; remuneration as fixed by the company.

Cutting Bros., Ltd. (81,178).—This company was registered on June 8th, with a capital of £6,000 in £10 shares, to acquire the business of electrical engineers now carried on by Cutting Bros., of Derby and London, to adopt an agreement with C. H. Cutting and G. H. Cutting, and to carry on the business of electrical engineers and contractors, electricians, manufacturers of and dealers in all apparatus used in the generation, distribution, supply, regulation, accumulation and employment of electricity, mechanical and ventilating engineers, founders, stampers, &c. The first subscribers (each with one share) are:—C. H. Cutting, 220, Uttoxeter New Road, Derby, engineer; G. H. Cutting, 220, Uttoxeter New Road, Derby, engineer; Isabella Cutting, 220, Uttoxeter New Road, Derby; Grace Winson, 22, Dairyhouse Road, Derby; J. B. Cutting, 220, Uttoxeter New Road, Derby, engineer; Mary Cutting, 220, Uttoxeter New Road, Derby; E. B. Cutting, 220, Uttoxeter New Road, Derby, engineer; and A. Cutting, 220, Uttoxeter New Road, Derby, engineer. No initial public issue. The number of directors is not to be less than two nor more than five; the first are C. H. Cutting and G. H. Cutting; qualification, £300; remuneration as fixed by the company. Registered office, 165, Parliament Street, Derby.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Okonite Co., Ltd. (69,327).—This company's annual return was filed on April 15th, when the entire capital of £120,000 in 32,000 preference and 16,000 ordinary shares of £2 10s. each. £2 10s. per share has been called up on 100 ordinary and 110 preference shares, resulting in the receipt of £525. £119,475 is considered as paid on 47,790 shares. Mortgages and charges: £65,900, of which £35,400 debentures are in the hands of trustees for the company.

South London Electric Supply Corporation, Ltd. (50,392).—This company's annual return was filed on May 10th, when the entire capital of £325,000 in 65,000 shares of £5 each had been taken up and paid for in full. No mortgages or charges.

Guildford Electricity Supply Co., Ltd. (36,725).—This company's annual return was filed on April 19th, when 3,191 preference and 2,692 ordinary shares had been taken up out of a nominal capital of £55,000 in 25,000 preference shares of £1 each and 6,000 ordinary shares of £5 each. £1 per share has been called up on the preference and £5 per share on the ordinary shares, resulting in the receipt of £16,651, in addition to £2 paid on two ordinary shares forfeited. Mortgages and charges: £21,000.

Indo-European Telegraph Co., Ltd. (3,953).—This company's annual return was filed on May 19th, when 17,000 shares had been taken up out of a nominal capital of £440,000 in 18,000 shares of £25 each. £25 per share has been called up, resulting in the receipt of £425,000. No mortgages or charges.

Willans & Robinson, Ltd. (40,660).—This company's annual return was filed on May 20th, when 66,666 preference and 66,666 ordinary shares had been taken up out of a nominal capital of £750,000 in 75,000 6 per cent. cumulative preference and 75,000 ordinary shares of £5 each. £5 per share has been called up on 52,208 preference and 52,204 ordinary shares, resulting in the receipt of £522,035. £144,635 is considered as paid on 14,463 preference and 14,462 ordinary. Mortgages and charges: £246,760.

Winchester Electric Light and Power Co., Ltd. (50,868).—This company's annual return was filed on April 18th, when 7,396 shares had been taken up out of a nominal capital of £50,000 in 10,000 shares of £5 each. £5 per share has been called up and £36,980 has been received. Mortgages and charges: £30,000.

Moelline Co., Ltd., electrical and general engineers, London (76,689).—Issue, on March 10th, of £250 debentures, part of series created March 29th, 1904, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital (if any). No trustees. Previously issued of same series: £11,575.

Cuba Submarine Telegraph Co., Ltd. (4,710 C).—This company's annual return was filed on May 25th, when the entire capital of £220,000 in 16,000 ordinary and 6,000 preference shares of £10 each had been taken up and paid for in full. Mortgages and charges: Nil.

Brompton and Kensington Electricity Supply Co., Ltd. (25,913).—This company's annual return was filed on May 3rd, when 27,920 ordinary and 12,080 preference shares had been taken up out of a nominal capital of £300,000 in 47,920 ordinary and 12,080 preference shares of £5 each. £5 per share has been called up on 26,920 ordinary and 12,080 preference shares, resulting in the receipt of £195,000. £5,000 is considered as paid on 1,000 ordinary shares. Mortgages and charges: Nil.

Hartlepool Electric Tramways Co., Ltd. (49,734).—This company's annual return was filed on May 4th, when the entire capital of £100,000 in 5,000 ordinary and 5,000 preference shares of £10 each had been taken up. £10 per share has been called up on the ordinary and £9 per share on the preference shares, resulting in the receipt of £95,000. Mortgages and charges: Nil.

General Electric Tramways Co., Ltd.—This company's annual return was filed on May 4th, when the entire capital of £18,500 in £1 shares had been taken up and paid for in full. Mortgages and charges: £15,000.

British Electric Calibrated Fuse Co., Ltd. (78,488).—Issue, on May 9th, of £300 debentures, part of series created December 4th, 1903, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. Lang, 137, Fenchurch Street, E.C. No trustees. Previously issued of same series: £1,050.

W. & E. Sumner & Clementson, Ltd., mechanical and electrical engineers, Liverpool (76,365).—Issue, on May 28th, of a debenture for £500, part of series created February 24th, 1903, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,500.

Potteries Electric Traction Co., Ltd. (57,968).—This company's annual return was filed on May 4th, when 24,439 ordinary and 24,440 preference shares had been taken up out of a nominal capital of £600,000 in 30,000 ordinary and 30,000 preference shares of £10 each. £10 per share has been called up on 17,833 ordinary and 24,500 preference shares, resulting in the receipt of £423,330. £66,666 is considered as paid on 6,666 ordinary shares. Mortgages and charges: £220,000.

CITY NOTES.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

The half-yearly general meeting of this company was held at 106, Cannon Street, E.C., on Tuesday.

The Hon. Henry Marsham, who presided, said that since the last meeting they had received no large contract which called for special notice. The cable shops had had their share of repairing work, the *Buccaneer* being employed at the end of last year by the Commercial Cable Co., while, at the beginning of this year, the *Dacia* was chartered by the Post Office for about 3½ months for work round the coasts of England and Ireland. The latter ship was now engaged in repairing the Atlantic cable of the Direct United States Co. With regard to cable manufacture, the machines had been busy with an order for 500 miles, which was shipped and despatched from their moorings about a month ago. In addition to this cable, they had had small orders from the British and Norwegian Governments, and from one or two companies. The Spanish Government asked for tenders for the laying of cables in the Mediterranean and between Spain and the Canary Islands. The directors went fully into the proposal which would entail financial arrangements of considerable magnitude, as the Spanish Government had adopted a system of paying by annuities during a period of 25 years. The result of the board's careful consideration was, that under the conditions offered they were of opinion that they were not justified in tendering, although the relations the company had had with the Spanish Government in past years had always been agreeable enough, and had the conditions of the advertisement been more favourable, the board would doubtless have submitted a tender. They had added another to the small electric installations which they practically financed, and the board believed that those businesses, which paid their expenses and their debenture charges and left a small surplus, would show some further development. The company was supplying to the Palmer Tire Co. the best motor tire on the market, but they anticipated infringement, and the consequent legal action, and shareholders must not, therefore, expect an increased revenue from this source until the patents were fully established in Court of Law. From what he had said they would understand why the board had thought fit to issue at not too favourable an opportunity, from a financial point of view, £100,000 of 4½ per cent. second debentures. These would be unified with the existing first mortgage debentures when the latter came forward for renewal. The price of raw material during the past six months had been abnormally high, but they had been fortunate in the stock they held. The chairman then moved that an interim dividend of 2½ per cent., or 5s. per share, be declared.

Colonel Weston Jarvis seconded the resolution, which was carried.

The Chairman mentioned that he had just returned from a visit to Japan, and he was pleased to say that in his movements among electrical houses there he found that the company's manufactures had an excellent reputation—particularly was that so in regard to their insulated cables, which stood first in the estimation of the Japanese.

An extraordinary general meeting followed, at which a resolution was passed repealing the articles of March 31st, 1864, and adopting the new articles which had been drawn up, so as to bring the company into line with the Companies' Act of 1900.

Mr. S. W. Silver, who was one of the parties to the adoption of the 1864 articles, seconded the resolution for adopting the new ones.

Lisbon Electric Tramways Co.

Col. Sir Charles Euan-Smith presided at the meeting held in London on 9th inst., and, in moving the adoption of the report, he said that one of its paragraphs referred to the fact that £19,000 odd had been expended, mainly on the cost and erection of an additional unit to the power house. At the time their engineers designed the power station, although ample space was provided in the building for an extension of the plant, no such development in the business was anticipated in the immediate future as that which had actually taken place. Their anticipations in this respect had, therefore, been falsified in a very agreeable manner, and the extension of the tramways had already rendered absolutely necessary the provision without delay of additional engine power to meet further development.

The motion was carried unanimously.

It was resolved that the directors be remunerated, in addition to their usual fee, to the extent of 1,000 guineas, free of income-tax, by way of a bonus in acknowledgement of their services to the company.

Mexico Electric Tramways Co.

Col. Sir Charles Euan-Smith presided at this company's meeting held in London on 9th inst. In moving the adoption of the report, he said that Messrs. Wernher Beit & Co. were creditors for £96,334, which sum was advanced by them from time to time for the extensions rendered necessary by the great growth of the traffic, and was not provided for in the original scheme of the capitalisation of the company. They could again point to a considerable increase in the passengers carried over the preceding year, and a corresponding increase in the receipts. Owing to the rapid development of the traffic, they had found it necessary to order a considerable addition to the rolling-stock, and had already added another unit to their power station. They had every reason to anticipate that for the current year their system would develop considerably and with success, and they were still making certain modifications and improvements on the system, which they anticipated would result in increased traffic at remunerative rates. The board invited Mr. W. B. Rommel, tramway and electrical engineer, to proceed to Mexico with a view to reporting as to the advisability or otherwise of certain changes which the directors had in contemplation, and during his visit he was able to carry out many improvements, the beneficial results of which were already appearing in the returns. Mr. Ludwig Breitmeyer also paid a short visit to Mexico in February of this year to assist Mr. Rommel. These gentlemen had concluded the purchase of controlling interest in the Banos Line Co., the only section of tramways in Mexico which remained out of their control, and which represented possibilites of competition. Their general manager in Mexico, Mr. Clegg, resigned his position, and was succeeded on April 4th by Mr. W. W. Wheatly, of New York.

Mr. Ludwig Breitmeyer seconded the motion.

The motion was carried unanimously.

Buenos Ayres Grand National Tramways Co.—The report for the year ended March 31st last, states that there is a net balance of £40,117, as compared with £32,831 in the previous year. A concession for the electrification of the company's system was obtained from the municipality on December 15th, 1903, and signed on February 10th, 1904, for a period of 55 years. For the purpose of this electrification the company has issued £300,000 conversion debenture stock, which, with the £100,000 to be exchanged for the second preference debenture stock, makes a total issue of £400,000. A concession for the electrification of the Nueva system has also been obtained on identical terms with the Grand National concession, and the Nueva Co. has made its corresponding issue of £150,000 conversion debenture stock.

Prospectus.—*The Sunderland District Electric Tramways, Ltd.*—This company has been before the public this week with an issue of 1,000 debentures of £100 each at par, bearing 5 per cent. interest. The capital previously issued was 600 similar debentures, 79,500 £1 preference, and 75,000 £1 ordinary shares. The company has some 15 miles of electric track in course of construction by Messrs. Krauss, the electrical equipment of the power house and line (including 30 double-deck cars) being in the hands of Messrs. Bruce Peebles & Co., Ltd. An estimate of the probable traffic, prepared by Mr. S. B. Cottrell, of the Liverpool Overhead

Railway, accompanied the prospectus, shows a net traffic revenue of £26,000. The amount required for debenture interest and sinking fund is £10,285. The list of applications was to close yesterday.

R. Waygood & Co., Ltd.—The report of the directors for the year ended March 31st states that the profits earned, including £4,949 brought forward, amount to £31,821. The managing director's and directors' fees absorb £2,800, the dividend on preference shares absorbs £8,100, patent rights, amount written off, £500, further amount placed to reserve £1,600, general reserve account £1,000, and interim dividend on ordinary shares £3,375, leaving a balance of £14,446. The directors recommend a further dividend at the rate of 13 per cent. per annum for the six months ended March 31st, making, with the interim dividend already paid, 9 per cent. for the year on the ordinary shares, leaving £6,074 to carry forward.

United River Plate Telephone Co.—The report for the year ended March 31st last to be presented at the meeting on 21st inst., states that gross receipts in sterling for the year at the River Plate were £134,824, as against £124,470 in the preceding year. Deducting debenture interest and interim dividends on preference and ordinary shares, and adding interest on investments and transfer fees, there remains a profit of £39,215, to which must be added £3,713 brought forward from the previous year, leaving an available balance of £42,928. After putting aside £10,000 to a reserve for renewal of plant and transferring £15,000 to reserve fund, the directors recommend a final dividend of 5 per cent. on the ordinary shares, making, with the interim dividend, 8 per cent. for the year, leaving £3,428 to be carried forward. To provide for the continued expansion of the business, it is proposed to increase the authorised capital of the company, and to make an early issue of £60,000 in ordinary shares, which will be offered to the ordinary shareholders.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to:—Metropolitan Electric Tramways, Ltd.—£350,000 4½ per cent. debenture stock. The Committee has appointed special settling days as under:—Wednesday, June 22nd: British Electric Traction Co., Ltd.—£250,000 4½ per cent. second debenture stock. The Committee has also ordered the undermentioned securities to be quoted in the Official List:—British Electric Traction Co., Ltd.—£250,000 4½ per cent. second debenture stock; Electrolytic Alkali Co., Ltd.—Further issue of 50,000 ordinary shares of £1 each, fully paid, Nos. 152,219 to 202,218; and a further issue of 50,000 7 per cent. cumulative preference shares of £1 each, fully paid, Nos. 50,001 to 100,000.

The Belfast Municipal Loan Issue.—The Belfast Corporation 3½ per cent. loan for £200,000 is reported to have been fully subscribed, but it is understood that of the amount issued stock to the extent of £56,000 has been taken by the Belfast Banking Co., who are treasurers to the Corporation. The issue was not favourably received by the local stock-brokers, who thought that better terms should have been offered. On the other hand, it is alleged on behalf of the Corporation that the poor result of the issue is due to an attempt on the part of those hostile to the tramway policy of the Corporation to demonstrate that the big loan for tramway purposes which has been foreshadowed cannot be obtained, and that consequently the system must be leased to a company.—*Financial Times.*

Nernst Electric Light, Ltd.—An extraordinary general meeting will be held on June 20th, at Westminster Palace Hotel, to confirm the resolutions already passed for reducing the capital of the company.

Commercial Cable Co.—The directors have declared a quarterly dividend of 2 per cent., payable on July 1st.

STOCKS AND SHARES.

Wednesday Evening.

Talk of heavy new issues in the highest-class markets, is accompanied by slightly firmer charges in Lombard Street, which have somewhat damped the hopes of those who looked for an early reduction in the Bank Rate. Money is plentiful enough in the market (whatever may be the case elsewhere), and a 2½ per cent. Rate seems to be an assured fact in the near future. The end of the half-year brings with it a certain amount of window-dressing on the part of the financial houses, but its effect is, of course, merely temporary. In the Stock Exchange the chief feature is the continued restraint of the public from the general markets, although the electrical sections manage to "keep up their end" very well, and there is a steady amount of trade passing in the Supply division.

As prices fell during the winter, when they should have been good, so are they capriciously rising now in the Electricity Supply list. Chelseas at 6½ have regained their loss of last week, and City Ordinary shares stiffened to 11¼. Kensingtons are 10s. better at 12½, London Electric Preference ¼ up at 5, and Edmundson's Ordinary ¼ to the good at 5¾. Charing Cross Debenture and London Electric Debenture stocks are both quoted *ex* interest, which is the reason for the decline of two points in each case. Several large lines of shares that were being sold for a decreased account have now been absorbed. Metropolitans at 20 are unaffected by the decision of the L.C.C. to lend the Borough of Marylebone the money for purchasing the company's undertaking in the borough.

Railway stocks on the whole are hanging on the heels of Consols, but Central London Ordinary is distinctly better at 94, the official price giving no clue to the change. The Preferred is marked up a point at 103½, and this market is a little better. Districts have improved a small fraction at 38½. Metropolitan Ordinary, after being sold by the profit-takers down to 96¾, rallied to 98. None of the lesser-known electrical railway stocks and shares have moved, but East London 3½ per cent. Guaranteed is 3 up at 97½.

Much is being said about the possible passing of its interim dividend on the Preference shares by the British Westinghouse Co. After what Mr. Westinghouse himself said at the last meeting of the company, we should think that most shareholders are quite prepared to lose the July dividend. From 3½ the price of the shares has recovered to 3¾, and the smartness of the rise makes one ask whether the movement is inspired from this side of the Atlantic or the other. British Electric Traction Ordinary and Preference are ¼ harder, at 10¼ and 11 respectively, thanks partly to the circulation of hints that an interim dividend of some sort will be paid, and that the company is doing well. These hints bear the plain stamp of having emanated from one certain quarter. London United Tramways Preference shares are 11¼, and the Debenture stock 104. Dublin United, 13 and 15½ for Ordinary and Preference shares respectively. Anglo-Argentine varieties remain steady, the Ordinary at 6—10s. premium on the issue-price—the Preference 5½, and the Debenture stock 133½, with none of the latter on offer. Some dealers sold a few hundreds the other day at 134, and afterwards wished they had not, since no stock comes to market. Auckland Electric Trams 5 per cent. Debenture is changing hands about 99½, and appears to be a sound investment of its kind, likely to advance in price later on. There is £200,000 of the stock, all issued and fully-paid.

British Columbia Electric Deferred keeps steady at 101½, the Preferred at 99½, and the 5 per cent. perpetual Preference shares are 10½. The Belfast Street Tramways, according to rumour, are shortly to be absorbed by the municipality, although the recent reception of Belfast's appeal for capital was not exactly encouraging to those who have to arrange the details of a new loan for the tramway's acquisition. The Ordinary shares of the Belfast Co. stand at 11 for the £10 fully-paid shares. Metropolitan Electric 5 per cent. Preference were done at 18s. 9d. last Tuesday. Buenos Ayres and Belgrano second Debenture is being bought, and the price has risen sharply to 104½.

Despite recent support from inside, Brush Preference are down ¼ to 20s., the other issues of the company remaining unaltered. Edison & Swan Debentures, of both kinds, are slightly higher, upon the new arrangements as regards the company's capital, but the shares keep simply steady. Industrials are a quiet market all round, the attractions of Ascot, the incidence of a nineteen-day account, and the Stock Exchange recess on Saturday helping to restrain business.

Improvement has begun to manifest itself in the American Railroad department, but Anglo-American Telegraph Preferred has shed a point at 91, although Commercial Cable Debenture recovered its fall of 1 and rose to 95 again. Anglo "A" is also easier at 7 middle. Otherwise Telegraph securities are uninteresting; the war in the Far East seems to have no effect upon them, one way or the other, nor does the possible revival of trade in South Africa, consequent upon the advent of Chinese labour, cause the public to take any notice of stocks in those companies which serve the districts to be affected. The achievement of Signor Marconi in at last rendering a daily newspaper possible on an ocean liner has barely influenced Marconi shares, which are 1¼, although the weakness in the Anglo-American group is not unconnected with this latest development of wireless telegraphy. Reuters at 7 have added 4s., the amount of the dividend. The India-Rubber, Gutta-Percha Co. declares an interim dividend of 5s. per share.

Upon a small investment inquiry, United River Plate Telephones improved 10s. to 6¼. The company's latest-issued report was very satisfactory, and the market say that the proposed new issue of shares will provide the proprietors with a bonus. Monte Video shares are ⅜—½. In the National Telephone group the Deferred registers a 2 per cent. rise at 87½, the other varieties continuing unchanged.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations June 8th.	Closing Quotations June 15th.	Business done week ended June 15th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —103	99 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 2⅜	2⅛— 2⅜	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	6⅛.	6⅜	6⅛.	48 — 51	48 — 51	..	..
3,105,880	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	91 — 93	93	92
3,105,880	Do. do. do. Deferred	Stock	2s.	1/-	2s.	7 — 7½	6⅞— 7⅛	7	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	..	4⅜— 5⅛	4¼— 5⅛	..	..
12,383,300$	Commercial Cable	$100	8 %	8 %	..	176 —185	175 —185	..	..
1,841,309	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 95	94 — 94	94½	..
16,000	Cuba Telegraph	10	4 %	6½%	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
12,981	Direct Spanish Telegraph	..	..	..	..	.. — ..	.. — ..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 —103	100 —103⅜	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10 — 10½	10 — 10⅛	10½	10⅛
85,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	100 —103	100 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	126 —131	126 —131	130	128¾
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	88	..
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	106	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11¾— 12¼	11⅞— 12¼	12⅛	11⅞
820,600£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,297	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	8¾— 9¼	8⅞— 9⅛	9⅜	8⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	13 — 13½	13 — 13½	13½	13⅛
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25 — 26	25 — 26	..	..
58,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	..	..	..	100 —103	100 —103	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	42 — 45	42 — 45	44	..
1,988,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	104 —106	105½	104½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	84 — 87	86 — 89	88	85
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	12½	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	..	..
600,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	98 — 101	99 — 100	98¼	..
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	104½	..
1,000,000	Do. do. Prov. Certs., 70 % to be paid	..	..	..	..	29 — 31	29 — 31	30	29½
179,313	Oriental Telephone and Elec. Nos. 1 to 171,604, fully paid	1	6 %	6 %	6½%	1⅜— 1⅝	1⅜— 1⅝	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	..	..	6¾— 7⅛	6¾— 7⅛ xd	..	..
8,808	Submarine Cables Trust	Certs.	..	..	..	117 —122	117 —122	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5¾— 6	6 — 6⅛	6⅛	5⅞
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞— 5⅛	4¾— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brax. Sub. Tel.	100	..	..	..	97 — 100	97 — 100	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	12⅜— 13⅛	12⅜— 13⅛	13	12⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100 —103	100 —103	..	..
88,831	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6⅜— 6½	6⅜— 6½	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

30,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	90 — 95	90 — 95	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅞— 10⅛	10 — 10⅛	10⅛	10
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10⅛— 11	10⅛— 11⅛	11	10⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	116 —119	116 —119	117½	116¾
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅛— 6	5⅛— 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —105	102 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅞— 1⅛	⅞— 1⅛	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	Nil	¾— 1	¾— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	8 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..
135,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
135,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	73 — 78	73 — 78	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	10 — 11	9¼— 10⅛	10⅜	9⅛
40,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5½— 5⅝	5½— 5⅝	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —108	104 —108	106½	..
1,960,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	93 — 95	92 — 95	91½	93¼
494,093	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —104	102 —105	..	..
494,993	Do. do. Def. do.	Stock	4 %	4 %	4 %	83 — 86	83 — 86	84½	84½
1,330,000	City and South London Railway	Stock	2 %	3½%	2½%	50 — 52	50 — 52	..	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1⅞— 2⅛	1⅞— 2⅛	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	95 — 98	95 — 98	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	⅛— ¼	⅛— ¼	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	⅜— ½	⅜— ½	..	..
44,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	73 — 78	..	..
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	74 — 79	75 — 79	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1⅜— 1⅝	1⅜— 1⅝	1⅝	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2⅛— 2⅜	2⅛— 2⅜	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¼— 9⅜	9¼— 9⅜	9⅜	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11⅛— 12⅛	11⅛— 12⅛	11⅛	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	19 — 20	19⅜	19⅛
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3¾— 4	3¾— 4	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	36 — 39	36 — 39	..	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	89 — 92	89 — 92	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share Lists.

Bank rate of discount 3 per cent. (April 21st, 1904

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years			Closing Quotations June 8th.	Closing Quotations June 15th.	Business done week ended June 15th, 1904.	
		‡	1901.	1902.	1903.			Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	1	..	..	..	⅜— ⅞	⅜— ⅞	¾	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛— 1⅜	1⅛— 1⅜	1¼	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	120 —125	120 —125	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	8 %	10 %	10½— 11	10½— 11	10⅛	10⅞
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10½— 10¾	10½— 10¾	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7½— 8	7½— 8	7⅝	7⅜
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅝— 5⅞	5⅝— 5⅞	5⅝	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4¾— 5	4¾— 5	..	..
40,000	Do. do. 1906	5	..	..	..	4¾— 5	4¾— 5	4⅞	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	102 —104 xd	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5½%	6 — 6½	6¼— 6⅝	6⅝	6⅜
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10⅜— 11½	11— 11½	11 7/16	..
40,000	Do. 5 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	13⅝	13½
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	121 —126	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	101 —104	101 —104	103½	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7½— 8½	7½— 8½	8	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11 — 12	11 — 12	11 7/16	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	106 —109	106 —109	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	99 —102	100 —103	101¼	100¼
60,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5⅜— 5¾	5⅜— 6	..	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	5⅜— 5¾	5⅜— 5¾	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	105 —108	105 —108	107½	107
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12½	11½— 12¾	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	103 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1¼— 1⅜	1¼— 1⅜	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4¼— 5	4¼— 6⅛	..	..
950,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	93 — 96 xd	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¼%	7½%	8¾%	19½— 20½	19½— 20½	20	19½
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅜— 5⅝	5⅜— 5⅝	5⅝	5½
230,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	109 —113	109 —113	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	..	..
10,883	Notting Hill Electric Lighting	10	6 %	6 %	6 %	12½— 13½	12½— 13½	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	..	..
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	5	..	..	..	8 — 9	8 — 9	8⅝	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	3 — 3½	3 — 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	1¾%	3 %	3⅞— 4¼	3⅞— 4¼	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	4⅛— 4¼	4¼— 5	4 3/16	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅛— 4¼	4¼— 5	..	..
110,000	Westminster Electric Supply, Ord.	5	10¼%	12 %	13½%	12¾— 13¼	12¾— 13½	13¾	12¾
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6¼— 6¾	6¼— 6¾	6¾	..

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, June 15th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£21 10	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£37 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	6/6	..
a	Potash, Bichromate, in casks ..	per lb.	5d.	..
a	,, Caustic (76/80%).. ..	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	220/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £180	..
c	Brass (rolled metal 2" to 12") basis	per lb.	6¼d.	..
c	,, Tube (brazed)	per lb.	8¼d.	½d. dec.
c	,, ,, (solid drawn).. ..	per lb.	7½d.	½d. dec.
c	,, Wire, basis..	per lb.	6¾d.	..
c	Copper Tubes (brazed)	per lb.	9½d.	..
c	,, ,, (solid drawn) ..	per lb.	9½d.	½d. dec.
a	Copper Bars (best selected ..	per ton	£69	£3 dec.

	METALS, &c. (continued).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£69	£3 dec.
g	,, Rod	per ton	£69	£3 dec.
e	,, (Electrolytic) Bars ..	per ton	£62	£2 dec.
e	,, ,, Sheets ..	per ton	£78	£2 dec.
e	,, ,, Rod ..	per ton	£72	£2 dec.
e	,, ,, H.C. Wire	per lb.	7¾d.	¼d. dec.
f	Ebonite Rod	per lb.	5/6	..
f	,, Sheet	per lb.	8/-	..
m	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	4/8 to 4/8½	dec.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	42/9	2d. dec.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£11 15s.	5/- dec.
g	,, ,, Sheet	per ton	£11 17s. 6d.	dec.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	,, ,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/- to 1/8	..
p	,, ,, strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	£4	..
c	Silicium Bronze Wire	per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars	per ton	£15 to £40	..
g	Tin, Block	per ton	£121 to £122	£2 dec.
g	,, Foil	per lb.	1/6	..
n	,, Wire, Nos. 1 to 16	per lb.	1/6½	..
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 les. Flax	per lb.	5½d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4½d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne brd.)	per ton	£25 5	..

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakespeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	No. wks.	Total to date. £	Total to date. £*	Miles open.	*
Aberdeen	June 11	1,419	+252	2	2,985	332	10	—
Birmingham ..	,, 11	5,569	+502	24	129,289	+ 7,274	8½	—
Bournemouth ..	,, 8	1,028	+ 45	10	11,093	—	10½	—
Blackburn	,, 13	1,092	+187	11	10,413	+ 660	13½	—
Blackpool	,, 9	940	+ 65	10	8,783	+ 668	6½	—
,, —Fleetw'd	,, 11	586	—316	24	8,215	— 683	7½	—
,, —Lytham	,, 9	435	— 227	32	7,385	+ 5,599	7½	—
Bolton	,, 12	1,880	—114	11	20,110	— 120	25	—
Bradford	,, 11	4,796	+1188	10	47,122	+ 1,987	46	—
Brighton	,, 12	912	+ 72	—	9,562	—	7½	—
Bristol	,, 10	5,118	+ 336	—	—	—	28	—
Devonport ..	,, 3	630	+ 73	22	10,791	+ 1,625	6	—
Dudley—Sto'rb'ge	,, 3	757	—361	22	17,768	+ 501	18½	—
Gateshead ..	,, 3	805	—168	22	19,302	+ 224	10½	+ ½
Gr'n'k—Pt. Glasgw	,, 3	617	+ 6	22	11,144	+ 659	7½	—
Hartlepool ..	,, 3	304	—142	22	5,868	+ 471	6½	+½
Oldham—Ashton ..	,, 3	698	—113	23	11,623	— 660	8	—
Potteries	,, 3	1,649	—177	22	36,933	+ 2,785	28½	—
Southport	,, 3	453	—316	22	6,300	+ 430	5½	—
South Staffs. ..	,, 3	712	—900	23	17,165	— 703	21½	—½
Swansea	,, 3	526	—194	22	11,095	+ 702	5½	—
Wolverhampton ..	,, 3	353	—447	22	8,126	— 354	10½	+6
Yorks. Wool Dist.	,, 3	569	— 28	22	12,403	+ 5,267	6	—
Miscellaneous ..	,, 3	3,305	—1498	22	54,337	+ 2,844	—	—
Burnley	,, 11	1,051	+345	—	—	—	10½	+3½
Burton-on-Trent ..	,, 6	344	—	9	4,289	—	8½	—
Cardiff	,, 4	2,166	—668	9	19,031	+ 580	14	—
Chatham & District	,, 9	606	+ 54	23	12,565	+ 1,335	6·68	—
Cork	,, 9	559	—113	73	9,807	— 687	9	—

Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	No. wks.	Total to date. £	Total to date. £*	Miles open.	*
Dover	June 11	204	— 14	23	4,332	— 246	3	—
Dublin	,, 10	5,607	+439	24	107,537	+ 2,316	47	+ ½
East Ham	,, 11	766	+177	10	7,946	+ 882	5	+ ½
Glasgow	,, 11	15,370	+846	2	25,377	— 2,716	70	+5
Halifax (2 weeks) ..	,, 11	3,593	—942	9	13,191	+ 499	33	+2
Huddersfield ..	,, 11	1,304	+186	10	—	—	28	—
Hull	,, 11	2,082	+266	10	21,858	+ 2,216	13	+2½
Ilkeston	,, 8	189	— 22	2	—	—	4	—
Ipswich	,, 11	489	—	10	4,906	—	10½	—
Isle of Thanet ..	,, 11	648	+ 25	23	8,513	— 397	10½	—
Leeds	,, 4	5,850	—1838	—	57,794	+ 2,860	81½	+2
Liverpool	,, 4	10,831	—1276	23	296,381	+ 3,676	103	—
London C. C. ..	,, 4	11,949	—928	9	105,411	+15,236	38½	—1½
Manchester	,, 11	12,559	—1194	10	122,176	+ 1,875	101½	—
Newcastle	,, 11	3,722	+617	—	—	—	17	—
Portsmouth	,, 11	1,965	+376	—	19,682	+ 1,778	14½	—
Salford	,, 6	4,118	—1490	—	39,506	+ 3,966	30	—
Sheffield	,, 12	4,612	+590	11	52,408	+ 1,537	33	+5½
Southampton ..	,, 9	1,056	—275	—	—	—	9	—
Southend-on-Sea ..	,, 8	328	+ 7	10	3,035	+ 144	6½	—
Sunderland	,, 12	1,200	+ 54	10	12,955	+ 505	20	+1
Tyneside	,, 2	368	+266	22	6,903	+ 770	8·9	+1·4
West Ham	,, 9	1,125	—	15	9,979	—	8	—
Wolverhampton ..	,, 8	624	+ 27	—	—	—	7·563	—
Cen. London Rly. ..	,, 11	6,781	— 31	24	165,187	— 2,655	6	—
City & S. Lon. Rly.	,, 12	2,628	— 98	24	71,598	— 2,224	6½	—
Dublin—Lucan Rly.	,, 12	132	+ 15	24	2,593	+ 207	8½	—
L'pool Overh'd Rly.	,, 12	1,618	+ 53	25	37,924	+ 27	8½	—
Mersey Railway ..	,, 11	1,895	+169	23	34,127	+ 7,085	4½	—

* Compared with the corresponding period of 1903.

THE RATEAU STEAM TURBINE.

By WALTER RAPPAPORT.

The state of the steam in a turbine is dependent on the area of the passages. Thus by making a rough sketch of a steam turbine and paying special attention to the size of the passages in the several sets of guide and moving blades in their relations to each other, one gains quite a clear idea of the action of the steam. This method has been adopted in figs. 1—5, demonstrating the principal types of steam turbines extant.

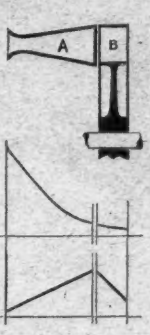


Fig. 1.—De Laval and Riedler-Stumpf.

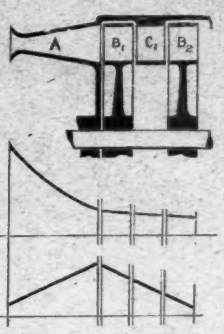


Fig. 2.—Riedler-Stumpf.

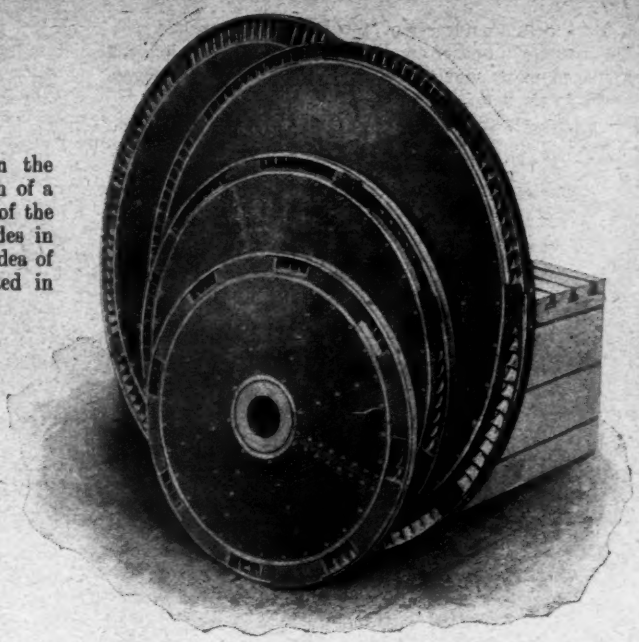


Fig. 8.—Diaphragms of Rateau Turbine.

Fig. 1 shows a sketch of a single-stage action turbine, system de Laval or Riedler-Stumpf. The steam expands in the conical nozzle A from boiler pressure to about condenser pressure, and acts upon the moving wheel, B, with the velocity thereby gained. Directly under the turbine sections in figs. 1—5 the corresponding pressure curves are drawn, and below these in figs. 1—4 the velocity curves.

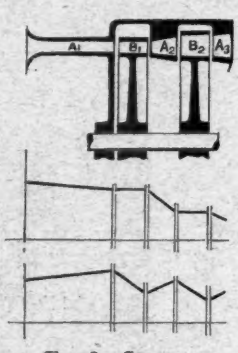


Fig. 3.—Curtis.

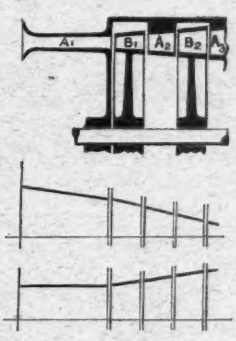


Fig. 4.—Parsons.

Fig. 5.

Fig. 2 shows also a pure action turbine, but the velocity attained through expansion does not act on one moving wheel only but on several; here, therefore, velocity staging is applied. This drawing corresponds to another type of the Riedler-Stumpf turbines.

Fig. 3 illustrates a turbine with pressure stages; the steam expanding in A only to a certain degree, acts upon B_1, with the attained velocity, expands more in A_2, acts upon B_2 and so on. Picturing to oneself velocity staging within each of the pressure stages, one sees that fig. 3 represents the action of a Curtis turbine.

If the steam expands not only in the fixed parts, A_1, A_2, &c., of the turbine, but if it is allowed to expand also in passing through the moving blades, one gets a construction corresponding to fig. 4, which represents the well-known Parsons turbine. In the specification of a new German patent, the proposition has been made to reconvert the velocity of steam, which it has gained by expansion, into pressure in the fixed nozzles A_1, A_2, &c., so that the pressure curves here shown are attained (fig. 5).

The pressure stage turbine of Parsons is a reaction turbine; the circumferential speed of the moving wheel must, therefore, be equal to the steam velocity in order to utilise the steam energy economically. In order to avoid too high a velocity, Parsons was obliged to make use of a very great number of pressure stages, thereby making his turbine very long and costly.

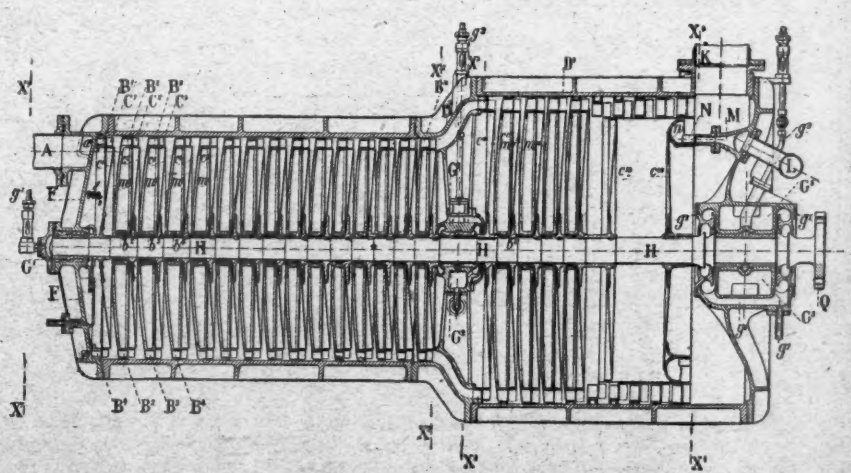


Fig. 6.—Longitudinal Section of Rateau Turbine.

All these drawbacks Rateau avoided in his turbine construction by letting each moving wheel revolve in a closed chamber, so that his turbine represents an action-pressure staging turbine. If, therefore, a Rateau turbine is to be

built for the same number of revolutions per minute as a Parsons turbine, all other conditions being the same, it needs only half as many moving wheels and is, in consequence, considerably shorter.

Fig. 6 shows a longitudinal section of a Rateau turbine, fig. 7 a view of the same with opened casing. This is a horizontal axial-flow turbine with 25 pressure stages. The steam enters at A, and is directed by guide blades B_1, that occupy a part of the circumference of the diaphragm m_1, on to the moving blades c_1. After having given up nearly all its velocity to the moving disk c_1, it passes to the guide blades B_2, which already occupy a larger part of the circumference of the diaphragm than B_1. The steam, therefore, expands gradually in the passages between the guide blades. At K the steam goes to the condenser. Within a chamber nearly the same pressure exists on both sides of the moving disk, so that only an inconsiderable axial thrust takes place, unlike the design of Parsons, who must counterbalance this end thrust by balance pistons.

For turbines for marine purposes, a certain axial thrust is, however, very desirable in order to balance the thrust of the propeller. For this purpose a part of the blade rings is attached to a drum without any partitions, the fixed blades being connected only to the enclosing cylinder, so that here a certain thrust takes place. This is the case also in figs. 6 and 7.

Another advantage claimed for the Rateau turbine over that of Parsons is that the possibility of leakage is far less. Parsons was obliged to reduce the clearance on the whole circumference between moving wheels and casing to a minimum, while in the Rateau turbine the steam can only leak through the small space between the diaphragms and the shaft.

These diaphragms themselves are shown in fig. 8 (p. 1009)

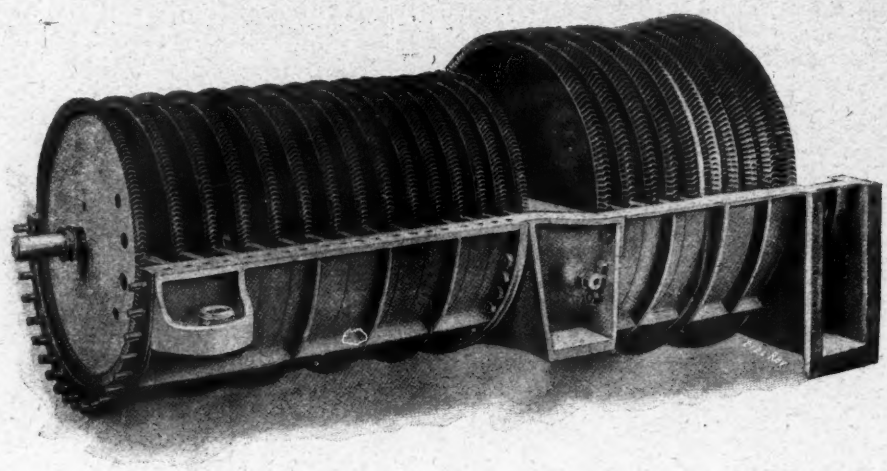


Fig. 7.—Rateau Turbine with Cover Removed.

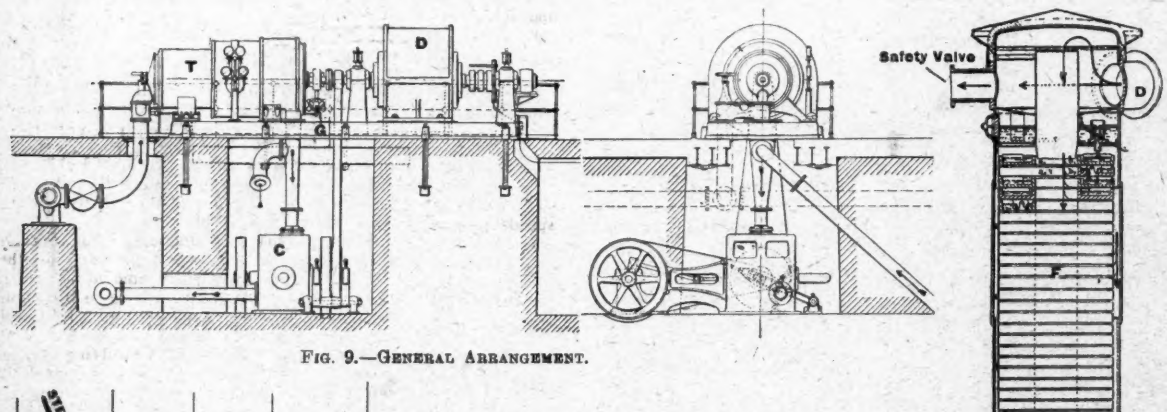


Fig. 9.—General Arrangement.

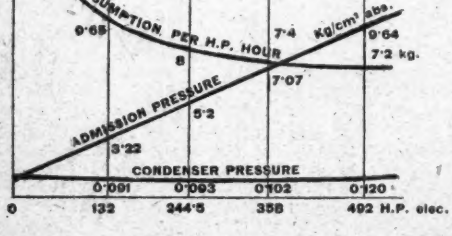


Fig. 10.

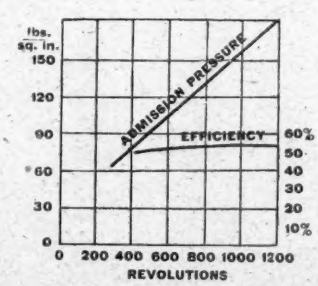


Fig. 11.

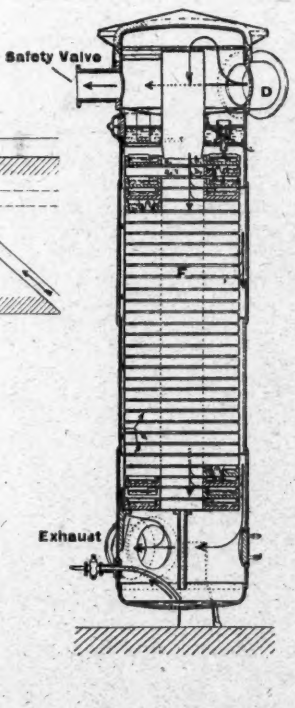


Fig. 12.—Heat Accumulator.

They consist of riveted steel plates which surround the shaft with a play of $\frac{1}{16}$ in., and are inserted steam tight in the casing. The shaft is carried at the ends of the turbine by two bearings, which are either cast separately and screwed on to the casing, or are cast in one piece with the latter. In larger turbines, as in the one represented by fig. 6, a third bearing is applied within the turbine. Special arrangements are made to prevent the oil, which is pressed into the bearing by a small oil pump, from penetrating into the turbine, otherwise the exhaust steam could not be led directly to the condenser, and from there back to the boilers, and thus a considerable advantage of the steam turbine would be lost. Very large Rateau

turbines are also divided into high and low pressure cylinders, their shafts being connected by a coupling, and carried in the middle by a bearing which is separated from both casings.

TABLE I.

No. of revolutions.	Pressure kg/cm² abs.			Load H.P. electric.	Steam consumption per electrical H.P.-hour.
	Boiler.	In front of turbine.	Condenser.		
2,050	12·0	9·6	0·115	512	7·17 kg.
2,213	„	„	„	526	7 0 „
2,420	„	„	„	536	6 95 „
2 025	16·0	9·6	0·115	520	7·05 „
2,259	„	„	„	537	6·83 „
2,429	„	„	„	545	6·72 „
2,011	16 0	11 0	0·128	606	7·05 „
2,225	„	„	„	626	6·81 „
2,429	„	„	„	643	6·61 „

Fig. 10 represents the result of a test on a 500-KW. turbine built by Sautter, Harlé & Co., of Paris. Still better results have been achieved by a renewed test of the same turbine, given in Table I.

TABLE II.—REVOLUTIONS PER MINUTE = 1,500.

Load KW.	Pressure kg./cm² abs.			Temperature Centigrade.	Steam consumption per KW.-hour.
	in the boiler.	in front of the first moving wheel.	Condenser.		
194	13·1	2·17	0·078	148	14·5 kg.
425	10·9	4·06	0 083	155	11 3 „
659	11·3	5·99	0·14	162	10 8 „
871	12·7	7·89	0 222	175	11 2 „
1,024	12·6	8·19	0 171	176	9 97 „

For rotating the turbine in a reverse direction, the blades N are provided, to which the steam goes through pipe L. This steam also flows off through pipe K to the condenser. To enable the turbine to be overloaded up to 50 per cent. without any damage, a pipe is led from the boilers directly to the guide blades in the middle of the turbine (not shown in fig. 6), through which high pressure steam is guided also to the second part of the turbine. Fig. 9 shows the general arrangement of a Rateau turbine with continuous current dynamo; T is the turbine, D the generator, and C the condenser (belt driven), the governor being represented by G.

In the accompanying tables and curves a number of results of tests are shown which have been made on Rateau turbines. First, Table II. gives the results on a 1,000-KW. turbine which has been examined in the test house of the Maschinenfabrik Oerlikon, of Switzerland.

Fig. 11 shows the efficiency of a Rateau marine turbine at different steam pressures.

Lastly, an apparatus may be mentioned that Prof. Rateau has developed in connection with his turbine, a heat accumulator. Such an accumulator consists of one or several vessels containing a great number of cast-iron dishes filled with water. It serves to store up the heat of the exhaust steam

TABLE III.—STEAM CONSUMPTION PER H.P.-HOUR IN KG.

Condenser pressure, kg/cm² abs.	Admission pressure, kg/cm² abs.		
—	2	1	0·5
0·08	9·3	12	16·5
0·13	10·7	14·4	21·5
0·18	12	16·5	28

of intermittently-working steam engines, and to give up the heat continuously and in the same degree to a low pressure turbine. In this way one is enabled to gain more than 500 H.P. from the exhaust steam of a colliery winding engine.

The action is as follows:—If the primary engine works the superfluous exhaust steam that the turbine cannot make use of at once is guided over to an accumulator which absorbs the heat by means of the cast-iron dishes and the water, and thus condenses the exhaust steam. By this the general temperature of the accumulator rises and the pressure correspondingly. While the primary engine is not working, the stored heat evaporates the water in the accumulator, and the pressure falls. Such apparatus are in action at present, one

TABLE IV.

Number of revolutions.	Load KW.	Pressure kg/cm² abs.		Temperature Centigrade.	Steam consumption in kg. per H.P.-hour.
		Admission.	Condenser.		
1,610	—	0·136	0·087	111·4	—
1,589	70·3	0·381	0·088	111	23·26
1,600	140·9	0·659	0 128	135	19·14
1,591	202·0	0 902	0 163	137	18·03
1,598	232·5	1·034	0·196	147	17·88

of them for the last year and a half in the mines of Bruay, in France. This one is built for stops of a minute, but nevertheless suffices for four minutes. The construction is shown in fig. 12.

The results of two tests of low pressure Rateau turbines in connection with a heat accumulator are given in Tables III. and IV.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE STEAM TURBINE AS APPLIED TO ELECTRICAL ENGINEERING.

By the Hon. CHARLES A. PARSONS, F.R.S.; G. GERALD STONEY; and C. P. MARTIN (Members).

(*Abstract of Paper read May 12th, 1904, in London.*)

In the early days of electric lighting the speed of dynamos was far above that of the engines which drove them, and therefore belts and other forms of gearing had to be resorted to. To make a high speed engine, therefore, was of considerable importance, and this led to the possibilities of the steam turbine being considered.

The first compound steam turbine constructed, in 1884, was of about 10 H.P., and ran at 18,000 r.p.m., the diameter of the armature being about 3 in. This machine, which worked quite satisfactorily for some years, is now in the South Kensington Museum.

Before, however, this first turbo-dynamo was constructed, a set of preliminary experiments were commenced at Gateshead-on-Tyne. Trial shafts were run in bearings of different descriptions up to speeds of 40,000 r.p.m.; these shafts were 1½ in. in diameter and 2 ft. long, the bearings being about ⅜ in. diameter. No difficulty was experienced in attaining this immense speed, provided that the bearings were designed to have a certain small amount of "give" or elasticity, and after the trial of many devices to secure these conditions, it was found that elasticity combined with frictional resistance to transverse motion of the bearing bush, gave the best results, and tended to damp out vibrations in the revolving spindle. This result was achieved by a simple arrangement; the bearing in which the shaft revolved was a plain gun-metal bush with a collar at one end and a nut at the other; on this bush were threaded thin washers, each being alternately larger and smaller than its neighbour, the small series fitting the bush and the larger series fitting the hole in the bearing block, these washers occupying the greater part of the length of the bush. Lastly, a wide washer fitted both the bush and block, forming a fulcrum on which the bush rested, while a spiral spring between the washer and the nut on the bush pressed all the washers tightly against their neighbours. This form of bearing was exclusively used for some years in turbine engines aggregating some thousands of horse-power, but it has since been replaced by a simpler form fulfilling the same functions. In the latter form the gun-metal bush is surrounded by several concentric tubes fitting easily within each other with a very slight lateral play; in the interstices between the tubes the oil enters, and its large viscosity when spread into thin films has the result of producing great frictional resistance to a rapid lateral displacement of the bearing bush; the oil film has also a centring action, and tends, under vibration, to assume a uniformity of thickness around the axis, thus centring the shaft, and like a cushion, damping out vibrations arising from errors of balance. This form of bearing has been found to be very durable and quite satisfactory under all conditions.

In 1888 several turbo-alternators of 120 H.P. were supplied for electric lighting stations, and at this period the total horse-power of turbines at work reached in the aggregate about 4,000, all of which were of the parallel flow type and non-condensing.

About 1890, however, on account of the temporary loss of control of the patents, the radial flow type of turbine was reluctantly adopted; this was in 1892 arranged to work condensing, and a 100-KW. plant single-phase alternator at 4,800 r.p.m., when tested by Prof. Ewing, was found to take only 27 lbs. per KW.-hour with 100 lbs. steam pressure moderately superheated to about 70° F. and with 27 in. vacuum, a result comparable with the best obtained by

reciprocating engines at that time, and thus a wide field was opened up for the use of the steam turbine as a prime mover. Many of these plants, mostly of 150 KW., were made for the electric lighting stations of Newcastle, Cambridge, Scarborough, and elsewhere. In 1894, on the recovery of the original patents, the parallel flow type was reverted to, with considerable improvements in design calculated both to increase the economy and decrease the cost of manufacture. The first large turbines of this improved type were of 350 KW. output, and were placed in the Manchester Square station of the Metropolitan Electric Supply Co.

In 1900, two 1,000-KW. turbo-alternators were supplied to the City of Elberfeld, in Germany.

These turbines were of the tandem type in which the expansion of the steam was first carried out in a high-pressure cylinder and completed in a low-pressure, but it was soon found that better economy, except possibly in very large sizes, could be obtained by having the whole turbine in one cylinder.

Large numbers of tests have been made from time to time, chiefly by various consulting engineers and station engineers, out of which the following are selected, as shown in Table I.

TABLE I.

At stop valve.		Vacuum. In.	Speed revs. per minute.	Load in KW.	Steam used per hour.	
Pressure above atmosphere. Lbs. per sq. in.	Superheat. F°.				Pounds.	Pounds per KW.
75-kw. Continuous-Current Turbo for Banbury.						
141·2	84·2	27·1	4,140	75·7	2,006	26·4
144	0	27·0	4,140	75·2	2,201	29·2
142	0	27·1	4,140	56·6	1,777	31·2
200-kw. Continuous-Current Turbo for Shipley.						
150	57	27	3,000	204·2	4,538	22·23
151	55	27·9	3,000	101·2	2,698	26·67
156	181	27·3	3,000	202·5	4,130	20·39
151	156	28·0	3,000	100·27	2,446	24·41
300-kw. Turbo-Alternator.—De Beers Explosive Works.						
150·0	53 3	27·88	3,000	312·1	6.260	20 06
153·0	50 0	27·78	3,000	231·8	4 960	21·45
150 5	40·2	27·9	3,000	154·5	3,670	23·75
1,500-kw. Turbo-Alternator.—Newcastle-on-Tyne E.S. Co.						
196	76	27·45	1,200	1,442	25,962	18·0
197	84	27·35	1,200	1,015·5	20,124	19·8
196	76	27·95	1,200	714·0	15,288	21·4
199	77	28·35	1,200	360·5	9,114	25·2
200	68	28·45	1,200	—	2,948	—
After 16 months' use the following figures were obtained:—						
203	92	26·11	1,210	1,823	32,431	17·7
207	66	26·46	1,208	1,513	27,582	18·23
1,500-kw. Turbo-Alternator for Sheffield Corporation.						
With vacuum augmentor, and including 450 lbs. steam per hour used by it.						
113·6	108·3	26·69	1,455	1,316·5	24,732	18·76
111·6	156·4	27·12	1,500	1,061·6	19,830	18·66
141	113	27·72	1,500	512·7	11,425	22·3
154	47·5	27·72	1,500	0	3,128	0
Without Vacuum Augmentor.						
115·6	143	25·18	1,500	1,029·3	21,264	20·7
137	119	25·97	1,500	534·25	12,820	24·02
150·3	72·4	26·62	1,500	0	2,957·4	0
3,000-kw. Parsons Turbo-Alternator Supplied to Frankfort by Messrs. Brown, Boveri & Co.						
138·5	235	27	1,350	2,993	44,200	14·74
170·5	187	27·5	1,350	2,518	38,300	15·59
142	120	27 2	1,350	2,600	41,200	15·8
139	114	27·2	1,350	2,600	41,400	15·9
168·5	184	27 9	1,350	1,945	30,800	15·84
146	120	27·6	1,350	2,000	32,600	16·3
137	101	27·4	1,350	1,442	25,400	17·6
142	30	29·3	1,350	0	4,700	excited
142	30	29·3	1,350	0	3,560	non-excited
In all the above tests the barometer is taken as 30 in. Superheat in degrees F., in all cases.						
500-kw. Turbo-Alternator.—Metropolitan E.S. Co.						
142	0	0	1,800	506·2	16,903	33 39
147	0	15·67	1,800	509 06	14,800	29·07
144	0	18·57	1,800	514 9	14,591	28·33
145	0	20·67	1,800	512·2	13,945	27·22
146	0	22·57	1,800	509·85	13,714	26·89
154	0	0	1,800	0	3,552	—
151	0	26·1	1,800	0	1,560	—

The effect of varying vacua is shown in a condensing turbine in fig. 1. The effect of varying load is shown in figs. 2, 3 and 4 for the 1,500-KW. plants for the Newcastle Electric Supply Co. and the Sheffield Corporation, which latter also shows the advantage gained by the use of the vacuum augmentor described in a later part of the paper, and also for the Frankfort 3,000-KW. turbine.

It will be seen that under the conditions of, say, 140 lbs. steam pressure and 100° F. superheat and a vacuum of 27 in. (barometer 30 in.) the consumptions are in round numbers as follows:—A 100-KW. plant takes about 25 lbs. of steam per KW.-hour at full load, a 200-KW. takes 22 lbs., a 500-KW. 20 lbs., a 1,000-KW. 19 lbs., a

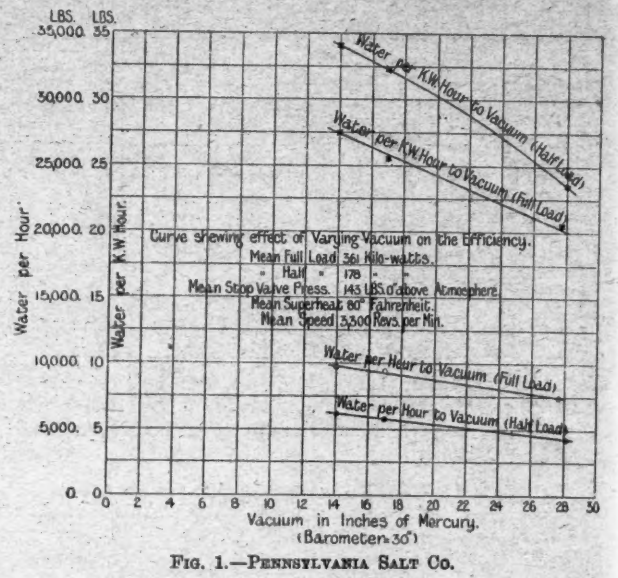

LBS.
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Water per Hour
Water per K.W. Hour
Water per K.W. Hour to Vacuum (Half Load)
Water per K.W. Hour to Vacuum (Full Load)
Curve shewing effect of Varying Vacuum on the Efficiency.
Mean Full Load 361 Kilo-watts.
" Half " 178 " "
Mean Stop Valve Press. 143 LBS. above Atmosphere.
Mean Superheat 80° Fahrenheit.
Mean Speed 3,300 Revs. per Min.
Water per Hour to Vacuum (Full Load)
Water per Hour to Vacuum (Half Load)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Vacuum in Inches of Mercury.
(Barometer 30")

FIG. 1.—PENNSYLVANIA SALT CO.

300-KW. generator; 250 volts; consumptions at varying vacua at full and half-load.

1,500-KW. 18 lbs., and a 3,000-KW. 16 lbs. These figures are derived from averages of a large number of tests which have been made from time to time. Without superheat the consumptions are about 10 per cent. more, and every 10° F. of superheat up to about 150° F. affects the consumption by about 1 per cent.

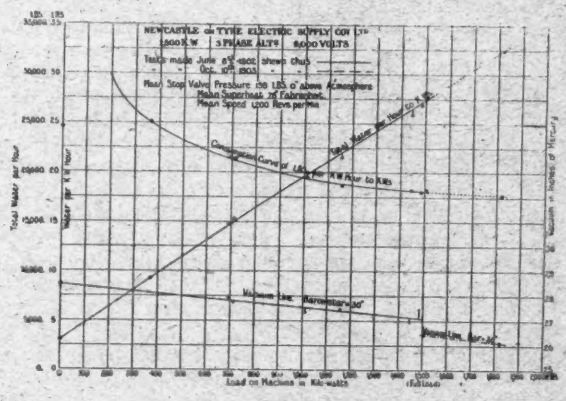

NEWCASTLE on TYNE ELECTRIC SUPPLY CO LTD
1500 K.W. 3 PHASE ALTS 6000 VOLTS
Tests made June 6th 1903 shewn thus
" " Dec. 10th 1903 " "
Mean Stop Valve Pressure 139 LBS. above Atmosphere
Mean Superheat 76° Fahrenheit.
Mean Speed 1200 Revs per Min
Consumption Curve of LBS. per K.W. Hour to K.Ws
Total Water per Hour
Water per K.W. Hour
Vacuum Line Barometer 30"
Pressure Line Bar. 30"
Load on Machine in Kilo-watts
Full Load

FIG. 2.

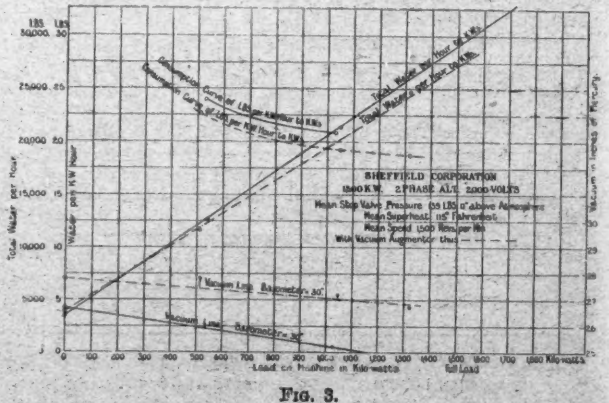

Consumption Curve of LBS. per K.W. Hour to K.Ws
Total Water per Hour
Total Water per Hour to K.Ws
SHEFFIELD CORPORATION
1500 K.W. 3 PHASE ALT. 2000 VOLTS
Mean Stop Valve Pressure 139 LBS. above Atmosphere
Mean Superheat 118° Fahrenheit.
Mean Speed 1500 Revs per Min
With Vacuum Augmentor thus
Vacuum Line Barometer 30"
Vacuum Line Barometer 30"
Water per K.W. Hour
Total Water per Hour
Vacuum in Inches of Mercury
Load on Machine in Kilo-watts
Full Load

FIG. 3.

A good vacuum is of great importance in a turbine, as the expansion can be carried in the turbine right down to the vacuum of the condenser, a function which is practically impossible in the case of a reciprocating engine, on account of the excessive size of the low-pressure cylinder and also of the ports, passages, and valves, which would be required. Thus, in a turbine, the benefit derived

from a good vacuum is much more than in a reciprocating engine, every 1 in. of vacuum between 23 in. and 28 in. affecting the consumption on an average about 3 per cent. in a 100-KW., 4 per cent. in a 500-KW., and 5 per cent. in a 1,500-KW., the effect being more at high vacua, and less at low. It is thus seen how a good vacuum is of importance in a turbine plant, and in this regard it may be well to look into the conditions necessary for obtaining the same. The first point is to avoid all air leaks, and this is easily accomplished in a turbine plant, as there are no packed glands and stuffing boxes to leak. The only places where leakage of air is possible are where the turbine spindle comes out of the cylinder, and here leakage of air is rendered very small by packing the glands with steam, so that any leakage which takes place is steam, and not air. The next is to have a suitable condenser, and in this regard sufficient area must be allowed by suitable arrangements of the tubes, and also ample way for the steam between them, proper velocities of the water in the tubes, sufficient supply of cooling water, efficient means of cooling the condensed water so as to keep the air-pump cool, and full provision for extracting by the air-pump and other means the inevitable small quantity of air which must leak in. By attention to these requirements, it is unnecessary to increase the size of the condenser beyond that used in ordinary practice, so that in the case of the most recent condensers for steam turbines from 10 to 12 lbs. steam is condensed per square foot per hour; and at this rate of condensation, vacua of from 27½ in. to 28 in., with barometer 30 in., can be obtained at full load. The amount of cooling water generally allowed is about 50 times the full-load steam consumption, which will increase the vacuum under normal conditions by about ¾ in. or 1 in. over that obtained by the usual 30 times the steam used. If we allow 14 ft. total head on the circulating pump due to lift, and for friction in the pipes and condensers, &c., which in most cases is excessive, especially where the return pipe is sealed, with 50 times the steam consumption in a plant taking 18 lbs. steam per KW.-hour, and assuming 50 per cent. efficiency in the pump and motor, the power used by the circulating pump is only 1 per cent., and with circulating water 30 times the steam consumption it would be 0·6 per cent., a difference of only 0·4 per cent., such a small difference as not to be comparable with the gain of 4 per cent. to 5 per cent. in the turbine by the use of increased circulating water.

(To be concluded.)

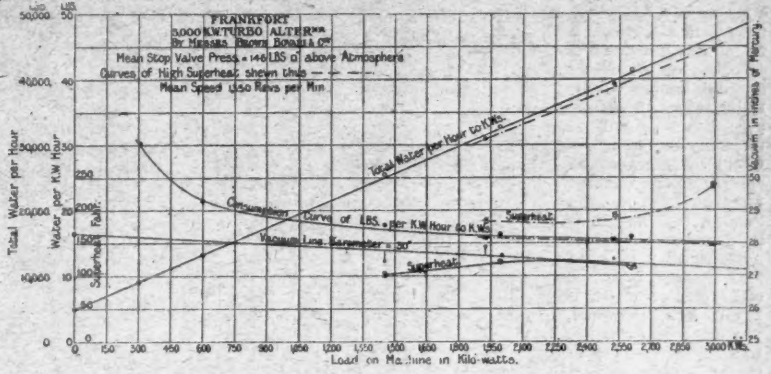

FRANKFORT
5,000 KW TURBO ALTERS
By Messrs. Brown Boveri & Cie
Mean Stop Valve Press. = 146 LBS. of above Atmosphere
Curves of High Superheat shewn thus — — —.
Mean Speed 1350 Revs per Min.
Total Water per Hour
Water per K.W. Hour
Superheat
Total Water per Hour to K.W.s
Consumption Curve of LBS. per K.W. Hour to K.W.s
Vacuum Line Barometer = 30"
Superheat
Vacuum in inches of Mercury
Load on Machine in Kilo-watts.

FIG. 4.

THE I.E.E. STUDENTS' SECTION.

THERE have been 11 meetings of this section during the past session, excluding the annual general meeting. The average attendance has been 36. The following papers were read:—

"A German Workshop," by F. Neuhaus, A.C.G.I.
"The Operation of Electric Lifts," by H. Church.
"The Equipment of a Sub-station with Rotary Converters," by O. J. Davis.
"The Equipment and Working of Small Private Generating Stations," by H. Purle.
"The Testing of Alternate Current Machinery," by R. J. Kaula.
"Automatic Railway Signalling," by E. Fisher.
"The Determination of the Correct Proportion of Condensing Plant in a Central Station," by P. V. Hunter.
"Notes on Commercial and Experimental Testing of Continuous Current Machinery," by L. A. Lewis.
"Armature Reactions in Alternators," by H. W. Taylor.
"Insulation and Insulators," by H. D. Symons.
"Alternating Current Commutator Motors," by F. Creedy, A.C.G.I.
"Some Notes on Steam Turbine Testing," by C. J. Seeley (read at the annual general meeting on May 18th).

Visits have been paid to the following works:—

County of London Co.'s supply station, City Road, N.
Incandescent Electric Lamp Co., Hammersmith.
India-Rubber, Gutta-Percha and Telegraph Works Co., Silvertown.
Baker Street and Waterloo Railway tunnelling works, Lambeth.
Central Telephone Exchange of the General Post Office.
Central Electric Supply Co., Marylebone.
Thornycroft & Co., Chiswick.
Board of Trade Electrical Standards Laboratory.
Metropolitan Electric Supply Co., Willesden, N.W.
Western Electric Co., North Woolwich.
Electrical Power Storage Co., Millwall.
Great Northern and City Railway.

During the Easter vacation a party of the Students' Section visited the Birmingham district. The number of students in attendance was 42, of whom 23 were from London. The various works in the district to which visits were paid have already been mentioned in the REVIEW.

On Friday evening, April 15th, the annual dinner took place at the Midland Hotel, with Mr. H. D. Symons, chairman of the Students' Committee, in the chair, and Mr. Vaudry and Mr. J. K. Catterson-Smith, assistant hon. local secretary, as guests.

The report is signed by Mr. H. D. Symons as chairman Students' Committee, and Mr. A. G. Ellis, the students' hon. secretary.

Gas Explosion.—A gas explosion which occurred at a Sunderland Hotel, on Monday, seriously injured four persons.

PHYSICAL SOCIETY.

AT the meeting held May 27th, 1904, Mr. J. Swinburne, Vice-President, in the chair, a paper entitled "The Law of Action between Magnets, and its Bearing on the Determination of the Horizontal Component of the Earth's Magnetic Field with Unifilar Magnetometers," was read by Dr. C. CHREE. Starting with the general formula for the action between two magnets perpendicular to one another, the paper discusses how observations should be combined when the higher terms usually neglected in magnetometer reductions are taken into account. The calculated values are compared with the mean values observed at Kew in past years in magnetometers of the several types; and conclusions are drawn as to the mean ratio of the pole distance to the total length of the magnets. The paper concludes with the results of some experiments on the degree of uniformity in the pole-distance of magnets of the same size and pattern.

Prof. H. L. CALLENDAR said that some time ago he made some experiments upon the distance between the poles of magnets, and the conclusion he came to was that it was impossible to express the pole-distance as a definite fraction of the length of the magnet. He had found that, among other things, the pole-distance depended upon the shape of the magnet, the intensity of magnetisation, and the kind of steel of which the magnet was composed. There was also a variation of the pole-distance with time.

Dr. CHREE said that Dr. Bö·gen had carried out experiments on different magnets under different conditions, and had concluded that the pole-distance was a constant fraction of the length of the magnet.

A paper "On the ascertained Absence of Effects of Motion through the Ether in relation to the Constitution of Matter on the FitzGerald-Lorentz Hypothesis," by Prof. J. LARMOR, was taken as read.

A paper "On Coherence and Recoherence," by Dr. P. E. SHAW and Mr. C. A. B. GARRETT, was read by Dr. Shaw.

Allowing that coherence itself is due to fusion, for which the evidence is abundant, recoherence may be due to (1) fusion, (2) molecular or inter-molecular change, brought about during coherence by the locally violent surgings at the contact.

Recoherence is still unexplained, and any explanation offered must take account of the observed effects, viz., that it is a sub-permanent effect following coherence, is unstable to various influences, and arises most often by reversal of current, but sometimes without such reversal.

PREVENTION OF ACCIDENTS IN WINDING.*

BY J. H. MERIVALE, M.A.

THE objects of the automatic gear, about to be described, the invention of Mr. T. Campbell Fyters, engineer, Broomhill colliery, Northumberland, are:—

1. The prevention of accidents, by substituting a simple mechanical contrivance for human agency.

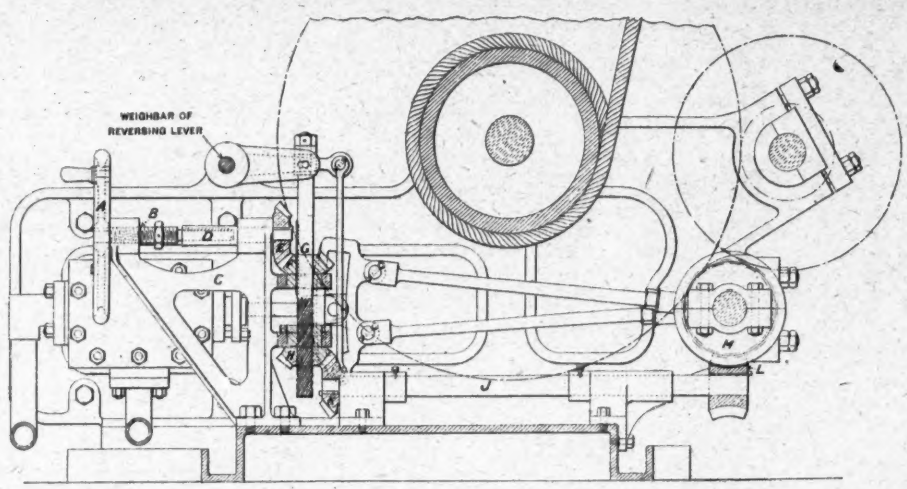
2. Lessened cost, as a highly-skilled brakesman is not required to take charge of the winding-engine. In fact, if necessary, it can be worked by the banksman, and the brakesman dispensed with altogether.

3. Economy of steam, as the gear automatically controls the steam valve (or, in the case of an electric winding-engine, the starting switch) and the signals of the winding-engine in such a way that over-winding is impossible, and the engine cannot be started until the signals have been given by both the banksman and the onsetter.

So far, it has been practically tried in its simplest form only, that is, without the automatic brake and signalling apparatus, at Broom-

* Abstract of paper read at the Institution of Mining Engineers, June 3rd, 1904.

hill colliery, upon a hoist, which has been in constant and successful use since November last. Fig. 1 shows the arrangement of the gear as applied to the steam-winch working the hoist. This engine is an ordinary ship's steam-winch, with a ratio of gearing of 13·6 to 1 between the engine-shaft and the rope-barrel; and it is not so suitable for the application of the controlling gear, as a direct-acting engine, such as an ordinary winding-engine, would be. The automatic gear is applied to the ordinary link-reversing motion, and takes the place of the reversing lever. It consists of a hand-wheel, A, mounted on a screwed spindle, B, working through the screwed boss of a bracket, C, and fitted telescopically into a spindle, D, carrying a mitre-wheel, E. The reversing weigh-bar has an arm fixed to it and attached to a vertical screwed spindle, G, which is keyed to a mitre-wheel, F, by means of a sliding feather, and is screwed into a mitre-wheel nut, H, which has a fixed position vertically on the bracket, C. This nut, H, gears with another mitre-wheel, K, attached to a spindle, J, on the other end of which is keyed a worm-wheel, L, gearing into a worm, M, fixed upon the crank-shaft of the engine.



Scale, 1 Foot to 1 Inch.

FIG. 1.

The action of the appliance is as follows: On the hand-wheel, A, being turned, the motion is transmitted to the vertical spindle, G, by means of the mitre-wheels, and the mitre-wheel nut, H, being held stationary, the vertical spindle, G, rises or falls according to the direction in which it is turned; and, being attached to the reversing weigh-bar, it raises or lowers the links, which start the engine, steam being always on. Immediately the engine starts, the worm, M, on the crankshaft, acting through the worm-wheel and mitre-wheel, turns the mitre-wheel nut, H, and so long as the mitre-wheel nut and vertical spindle, G, turn in the same direction, and at the same rate, no up-or-down motion of the vertical spindle, G, will take place, so that the reversing links will remain stationary. On the hand-wheel, A, being stopped, the vertical spindle, G, stops also, but the mitre-wheel nut continues to be turned by the engine, and raises or lowers the vertical spindle, G, and consequently the reversing links, until they are brought to their mid-position, and then the engine stops. The hand-wheel spindle, B, being screwed and provided with stops, it follows that the number of revolutions is limited to the distance between the stops and to the pitch of the screw. By properly proportioning the number of revolutions of the hand-wheel, A, to the number of revolutions of the engine required for the distance of the wind, there can be no over-winding, as the hand-wheel cannot be turned further, once it comes against the stop, and then to move the engine the hand-wheel must be turned in the opposite direction, and this reverses the engine. Further than this, the hand-wheel, A, must be kept in motion or the engine stops, and consequently should the engineman be seized with any sudden illness, so as to prevent him from turning the hand-wheel, when drawing men, no accident to the men could occur, as the engine and cages would simply come to a standstill; as the engine is absolutely controlled both in speed, starting, stopping, and reversing, by the one hand-wheel, which can only be turned a fixed number of times in either direction, little or no skill or training is required of the engineman, and, in cases of emergency, the engine could be handled by anyone with perfect safety.

The apparatus may evidently be modified in various ways to suit special circumstances. An arrangement can be applied to a direct acting winding-engine, in which the gear also automatically controls a steam brake. When the hand-wheel is turned so as to raise or lower the reversing link, it also puts the steam-brake valve into position for releasing the steam brake, and, when the engine automatically raises or lowers the reversing links to stop the engine, it simultaneously turns the steam-brake valve so as to apply the brake, which of course may be proportioned so as to give any amount of braking power.

In the case of heavy engines, where it is necessary to have steam-reversing apparatus, the motor could be sufficiently powerful to take the place of this apparatus, and would be controlled with a starting and speed-regulating switch. In either case, the motor being arranged to work with a friction clutch, the clutch would slip in case the motor continued to turn after the horizontal spindle, B, was screwed up to the stops: or, by means of an automatic quick-break switch (to be presently described), the motor may be made to stop after a certain number of revolutions corresponding to the number of revolutions of the hand-wheel spindle, B, but the actual number of revolutions of the engine would be absolutely fixed by the stops.

The apparatus can also be arranged so as to be worked by the banksman, the winding-engineman being altogether dispensed with. Fig. 2 shows the electrical connections for this purpose. A and B are two ordinary starting switches, with a small holding-on magnet and no-voltage release. The motor is series wound. C is an automatic quick-break switch, worked by the engine or motor—in this case by the motor. Figs. 3 and 4 show the proposed arrangement of the switch. It will be seen that movable contacts are arranged upon a barrel, which has two positions, one in which the circuit is closed for the motor working in one direction, and the other for the reverse; and it is always in one or other of these two positions.

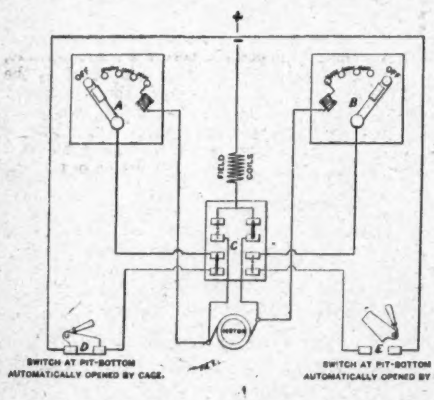
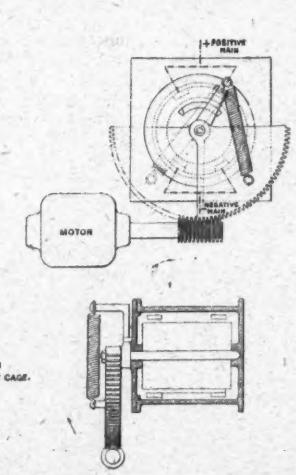


FIG. 2.



FIGS. 3 AND 4.

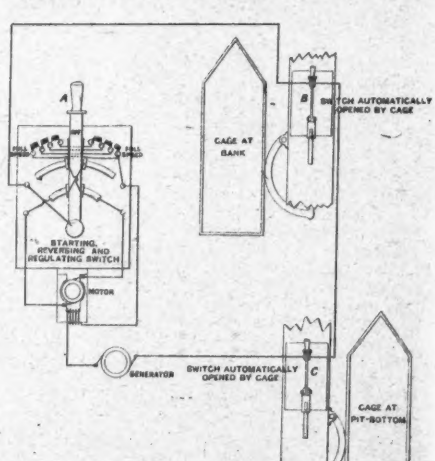


FIG. 5.

Following the diagram (fig. 2) of connections, and assuming that the automatic switch is in position to make contact as shown by the continuous lines, and the switch, D, at the pit-bottom is closed; if the starting handle on the switch, A, is pushed over, the motor at once starts the winding-engine, so as to lower the cage on that side nearest to the switch, and the handle is kept over by the holding-on magnet. Immediately the motor revolves, it turns the worm-quadrant (fig. 3), and this, at the end of the wind, brings the spring into the position shown by the dotted lines; the spring being then extended, the force is sufficient to turn the switch-barrel quickly over, breaking the electrical connection on that side, and making connection on the other. Simultaneously, the switch, D, at the pit-bottom is opened automatically by the cage on reaching the pit-bottom. At once the electrical connection is broken, the current is cut off from the motor, and the handle on switch, A, flies back to the off position, and it is then impossible to start the engine by this switch, as the electrical connection is broken (*a*) by the automatic switch, C, and (*b*) by the switch, D, at the pit-bottom. Moreover, the banksman cannot start the engine in the reverse direction until the onsetter closes the switch, E. It may also be mentioned that, should any of the electrical connections break or the current fail during winding, the engine would simply come to a stop.

An arrangement has been devised so that the brakesman cannot start the engine before receiving the signal from both the banksman and the onsetter; accidents due to the brakesman starting to wind before he has received the proper signals are not uncommon under present arrangements. Fig. 5 illustrates the electrical connections of an arrangement in which the brakesman is retained, but by means of an electrically-controlled apparatus, he cannot start the winding engine until the circuit is completed by both the banksman and the onsetter, and, moreover, should either the banksman or the onsetter require to stop the engine after it had started, either of them could do so without the co-operation of the brakesman. A is a starting and regulating switch, controlling the motor in the engine house, and worked by the brakesman; B and C are two switches at the top and bottom of the pit respectively, and arranged so that they are automatically thrown out by the cages, and that the circuit is broken both at the top and bottom of the pit. Before the engineman, therefore, can start the winding engine, both the banksman and the onsetter must close the switches, B and C, and keep them closed until the cages have moved, as they are so arranged that they will not remain closed so long as the cages are at the top and bottom of the pit respectively. At the same time, as the circuit is completed, a bell may be arranged to ring at the various points, namely, in the engine room, on the bank-top, and at the pit-bottom, so that each one is aware that the engine may start.

Where electrical power was in use for winding, the gear would be arranged to act upon the starting and regulating switches, controlling the motor or motors working the winding drum, in much the same way as upon the reversing link mechanism of steam engines.

ELECTRO-CULTURE.

An interesting and at the same time an encouraging renaissance has lately been observed in various parts of Europe. This is the movement that has lately taken place—after many years of neglect—in favour of the application of electricity to agriculture, not only in the driving of all kinds of agricultural machinery, including the plough, but also in the influence brought to bear by electricity itself on vegetation and germination. In France quite recently the Minister for Agriculture sent to prefects and sub-prefects a circular instructing them to facilitate in every possible way the application of electricity to agricultural operations, and setting forth the advantages that agriculture and industry in general would derive therefrom. In Belgium still further progress has been made, as the interesting question of electricity in agriculture has been introduced into the university curriculum. The Minister for Agriculture has found the subject of sufficient interest for him to commission M. Guarini to devote to it at the Agricultural Institute at Gembloux a series of lectures on the questions we are about to enumerate.

We will not go into the description of the numerous experiments shown by the lecturer, nor into the contradictory results obtained by experimentalists in different countries. As to the latter, we will merely remark that the products obtained by electro-culture are very abundant, very fine, and very quickly matured. We will confine ourselves to the ideas put forward by M. Guarini, with special regard to his theories for the chemical and mechanical explanation of the satisfactory results obtained by the application of electricity to vegetation. For the last 40 years, particularly since the researches of the German scientist Sachs (1865), our ideas with regard to vegetable physiology have been fairly definite. We can now easily explain to ourselves the function of each part of the plant, the *raison d'être* of each organ, and of its form. Moreover, we know a great deal about the function of chlorophyll, in particular of what it consists, and what it requires to stimulate its production, and to render it more active. But, on the other hand, we are completely in the dark as to how and by what means carbonic acid is decomposed in chlorophyll into carbon and oxygen.

M. Guarini asks whether in these days, where so many things are explained by electricity, we are not justified in thinking that plant life also is based on electrical phenomena; he asserts that this is so. In the first place, he remarks that contrary to what is believed and taught, it is not electricity that can be substituted for light in certain cases in the accomplishment of the function of chlorophyll, but the light of the sun and of arc lamps, with its electrical radiations, that can be substituted for purely electrical treatment. We have the best proof of this statement in the following experiment:—

A plant placed in a pot which is enclosed in a metal cage (a Faraday cage) dies, although it is exposed to the sunlight. This, says M. Guarini, is because the plant is deprived of the *indispensable* influence of atmospheric electricity, and particularly of the electric radiations of the sun. On the other hand, if a plant is placed in absolute darkness it can produce much finer and more abundant fruit in less time than under natural conditions if judicious electrical treatment is applied to it. With regard to the experiment with the Faraday cage, for the plant to die it must be in a pot completely surrounded by the metal cage. When the plant is in the earth, although we suppress the influence of the solar radiations and of the current going from the atmosphere to the earth, we do not completely suppress that which passes from the earth to the atmosphere. Every time it rains, hails, or snows, for instance, the potential of the earth changes from its usual negative nature to positive.

M. Guarini reminds us that in the Faraday cage we have no charge inside if we have one outside, but we get one outside if we have one inside. When a plant is placed in the earth and surrounded by a metal cage it does not completely perish, but, as Messrs. Grandeau and Leclerc's experiments have shown, there is a diminution of 50 to 70 per cent. in the leaves and stalks, and 50 to 60 per cent. in the seeds and fruits, as compared to what it bears when there is no cage.

After this introduction, M. Guarini explains as follows the influence of electricity on the principal vital functions of the plant, *i.e.*, nutrition, respiration, and transpiration.

Nutrition.

1. *Aerial Nutrition.*—The current which passes through the plant from the atmosphere to the earth, or *vice versâ*, decomposes the carbonic acid in the chlorophyll into carbon and oxygen. M. Guarini then performs the following experiment:—He injects carbonic acid into a vessel of water from which proceed two electrodes connected with a current of 110 volts. There is at once a deposit of carbon on one of the electrodes. He announces, moreover, that he has obtained formic aldehyde in collaboration with Dr. Samarani of the Agricultural Institute at Gembloux. Special conditions of voltage and amperage are required for this. All this is perfectly in accordance with the experimental results obtained by the Russian Walther in his experiments on the synthesis of sugars by electrolysis, in which the original material consisted of carbonic acid.

2. *Nutrition in the Earth.*—The currents which pass through the earth whether natural (earth currents) or artificial (generated by batteries, accumulators, dynamos, &c.), decompose the chemical substances found in the earth or added to it in order to form nourishment more easily assimilated by plants.

3. *Distribution of Aliments.*—Mr. Guarini pointed out that in arc lamps on the one hand, and electrolysis on the other, material was conveyed from the positive to the negative pole; he also referred to the experiments of Prof. Lemström, of the University of Helsingfors, who was able to make water rise in a capillary tube immersed in a basin, in which was placed the positive pole of a static machine, the negative pole of which was connected with a point touching the upper part of the capillary tube. When, therefore, the potential of the earth is positive, or rendered so artificially, and the potential of the atmosphere is, above the plants, rendered negative, the current which goes from the earth to the atmosphere draws with it the water and alimentary substances, *i.e.*, promotes the circulation of the sap.

Respiration.

This means the inhalation of oxygen through the pores of the capillary vessels. When there is a current passing from the atmosphere to the earth, the oxygen is carried along in the direction of the current—*i.e.*, downwards—and is driven out with more or less force through the pores, and thus respiration is kept up.

Transpiration.

This consists in the plant giving off the products of combustion, carbonic acid and aqueous vapour. When there is a current passing through the plant in an upward direction, the result is contrary to what takes place in respiration—*i.e.*, the current drives the gases of combustion out of the pores.

To all these chemical and mechanical effects must be added another of considerable importance. Prof. Lemström shows that when a high-tension electric current is applied to plants, there is produced ozone in large quantities, nitric acid, nitrous acid, and, perhaps, ammonia. Now, we know that the oxygen derived from the ozone is highly active, as is shown by the increased verdure of plants after a storm. From what M. Guarini says, it follows that for respiration the plant must be traversed by a current going towards the earth, whereas for transpiration the current must go towards the atmosphere, whilst in the case of nutrition the direction of the current is immaterial. As nutrition and respiration are the two most important functions of plant life (transpiration being a consequence of these two functions), it follows that the best result is obtained when the plant is traversed by a current going towards the earth, which would correspond to the normal electric condition of the atmosphere and the earth. M. Guarini, in order to prove that experiment agrees with theory, showed photographs, obtained by Prof. Lemström during his experiments with a static machine of his own invention. With the aid of these photographs, one can see and compare the results obtained

from carrots, the layer of atmosphere surrounding them having been electrified (1) positively, (2) negatively, (3) positively and negatively, and (4) not electrified at all. When the atmosphere is electrified negatively, *i.e.*, when there is a current towards the atmosphere, the carrots are better than when there is no electrical treatment.

In this case, as we have said, there is increased activity of nutrition and transpiration. The results are incomparably better when the atmosphere is electrified positively, *i.e.*, when the current goes towards the earth. In this case, we not only force respiration and nutrition into greater activity, but—and this is most important—we send into the plant a greater quantity of carbonic acid, *i.e.*, a greater quantity of nourishment.

The illustration presented by the lecturer also showed that very deplorable results were obtained when currents of both kinds were applied.

Finally, the lecturer remarked that in order to derive the greatest benefit from electrical treatment it is necessary: (1) to place the plant in an environment where there is much more carbonic acid than in the atmosphere. This can easily be done in glass houses that are entirely closed; (2) to accustom the plants, perhaps, after a certain number of generations, to forced alimentation, transpiration and respiration, and so to a much more rapid mode of life.

By these methods and by judicious electrical treatment, production can be pushed to extreme limits, and several crops a year obtained.

As to the sources required for the electrical treatment, M. Guarini mentions the three following:—

1. Atmospheric electricity. None of the arrangements employed completely answer the purpose required. The sources of the atmospheric currents must be placed in much higher positions than they have yet been, so that there may be sufficiently high differences of potential between the top of the rods and the earth, and sufficient to overcome the resistance of the plants and of the layer of air separating the lower part of the rods from the plants, that part of the air in which currents are produced and consequently ozone.

2. Static machines. He rejects these for the present as expensive and delicate toys, easily put out of order, and incapable of producing the intense effects required.

3. High-tension continuous-current dynamos; these are both inexpensive and strong. By using them instead of atmospheric electricity, the electrical treatment can be regulated at will.

M. Guarini mentioned in this connection that the Société des Industries Electriques et Mécaniques, of Geneva, has recently brought out a continuous-current dynamo capable of giving one ampere at 23,000 volts, and that by coupling three of these machines in series, the high figure of 69,000 volts is obtained, a value more than sufficient for electro-culture.

Lastly, he concludes that plant life is an electrical phenomenon which can be regulated at will. The farmer will no longer be a mere machine, but a skilled and more or less intelligent electrician, who, like an engine driver, will direct from a board at the farm the germination and growth of his carrots, potatoes and cabbages.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

12,213. "Improvements in electrical timing devices for fire brigade competitions, military drill, race meetings, and the like." A. E. Nichols and A. C. Brown. May 30th.

12,214. "Improvements in electrical cooking and heating apparatus." The British Prometheus Co., Ltd., and H. Skipwith. May 30th.

12,245. "Improvements in and relating to electric switches, circuit-breakers and the like." The British Thomson-Houston Co, Ltd., and A. S. Cubitt. May 30th.

12,246. "Improvements in means for starting electric flame arc lamps." E. A. Carolan. (The General Electric Co., United States.) May 30th.

12,247. "Improvements in and relating to electrodes and lamps for arc lighting." E. A. Carolan. (The General Electric Co., United States.) May 30th.

12,248. "Improvements in means for starting electric flame arc lamps." E. A. Carolan. (The General Electric Co., United States.) May 31th.

12,267. "Improvements in electrical resistances." W. J. Davy. May 30th.

12,268. "Installation and apparatus for automatically putting alternating current transformers into or out of circuit." J. A. E. Mariage. May 30th (Complete.)

12,298. "An improved appliance for gripping and supporting the wires of overhead wire systems for electric traction." J. H. Luby and W. Harris. May 31st.

12,333. "Improvements in and relating to high tension electric switches." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) May 31st.

12,334. "Improvements in and relating to the construction of dynamo-electric machines." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) May 31st.

12,335. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) May 31st.

12,336. "Improvements in and relating to alternating-current electric meters." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) May 31st.

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12,543. "Improvements in and relating to trolleys for electrically driven vehicles." T. D. Whitehead. June 2nd.

12,545. "Improvements in and relating to alternating current electric meters." Allgemeine Electricitäts-Gesellschaft. June 2nd. (Date applied for under Patents Act, 1901, June 2nd, 1903, being date of application in Germany.) (Complete.)

12,568. "An improved electric meter." J. D. F. Andrews. June 3rd.

12,593. "An improved self-locking joint for connecting canes or rods together in sections, as used in clearing drains, sweeping chimney flues, passing telephone wires and the like through conduits." A. E. Hubert and W. Edwards. June 3rd.

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